

Next Generation Space Defense

# Milsat Magazine

April 2021

**NAT'L SECURITY SPACE ISSUES  
SPACE ASSETS DEFENSE  
OPIR POLAR SATELLITES  
SSA  
EIS  
SPACE REPORT**

S7758

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## SPACE & MISSILE SYSTEMS CENTER TO BE RE-DESIGNATED AS THE USAF'S NEW SPACE SYSTEMS COMMAND



The [U.S. Space Force](#) has released the organizational structure for the military arm's new Space Systems Command — the Command is set to officially stand up in the summer of 2021, once all required conditions are met to re-designate the Space and Missile Systems Center at Los Angeles Air Force Base, California, as SSC headquarters.

SSC will rapidly identify, prototype, and field innovative, space-based solutions to deliver swift and responsive space capabilities to meet the demands of the National Defense Strategy.



*"Space Systems Command's organizational structure was purpose-built to anticipate and be responsive to the challenges presented by a contested space domain,"* said General **John W. "Jay" Raymond**, USSF Chief of Space Operations. *"We took the SMC 2.0 transformation of 2019 to the next level, aligning missions and organizations, and pushing authorities down from*

*the three-star level to lower echelons in order to reduce cost and go fast. This will allow us to move at speed in delivering the resilient space capabilities necessary to stay ahead of a growing threat."*

The establishment of SSC will elevate the current responsibilities of SMC to that of a U.S. Space Force Field Command. SSC will be responsible for developing, acquiring, equipping, fielding, and sustaining resilient space capabilities to enhance joint lethality. This includes launch,

developmental testing, on-orbit checkout, and sustainment. SSC will also provide strategic oversight of USSF science and technology activities.

*"SMC led the nation in developing and delivering unparalleled, enduring space capabilities to the warfighter and our nation's allies,"* said Lieutenant General **John F. Thompson**, SMC Commander. *"With the re-designation of SMC as SSC, we will further build upon the success seen with SMC 2.0, while synchronizing the science and technology research, capability development, system production, launch operations, and system sustainment efforts to more effectively deliver cutting-edge space systems needed to ensure the future of our national security and prosperity. Furthering our focus on accelerating the pace of acquisition while still delivering excellence, we will continue to emphasize more partnerships and more innovation."*

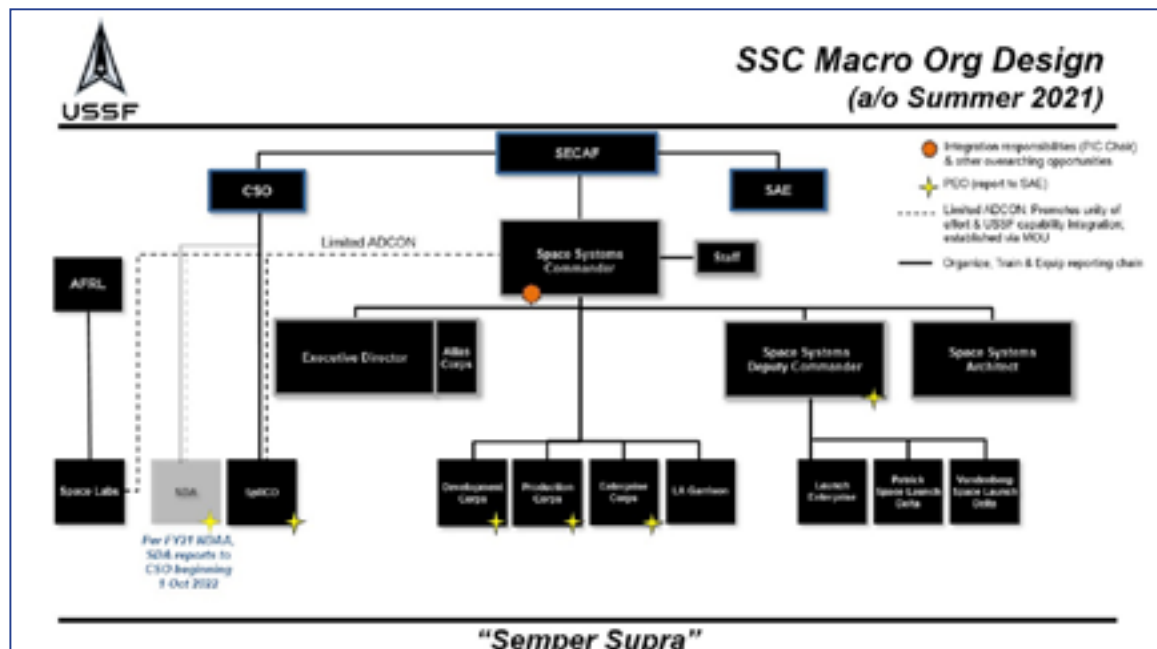


One of the required conditions to establish SSC will be met after a USSF general officer is nominated by the President and confirmed by the U.S. Senate to fill the position of the three-star general officer SSC commander.

The SSC deputy commander will be a two-star USSF officer, who will also serve as the *Assured Access to Space* leader, responsible for integration and oversight across the entire Launch Enterprise.

Upon official establishment, additional units will realign from the U.S. Air Force to the U.S. Space Force or re-designate as part of SSC. As these units and mission sets realign to the Space Force and SSC, military and civilian personnel in those units will also be assigned to the new armed service.

No geographic moves of personnel or units are anticipated as a result of actions required to establish this Field Command.



## These unit changes include:

- SMC subordinate units will realign to SSC.
- The **61st Air Base Group** at LAAFB is projected to be re-designated as the **Los Angeles Garrison**, aligned under SSC.
- The **30th Space Wing** at Vandenberg AFB, California, will be re-designated as **Space Launch Delta 30** and the **45th Space Wing** at Patrick Space Force Base, Florida, will be re-designated as **SLD 45**. **SLD 30** and **SLD 45** and their respective subordinate units will realign from under Space Operations Command to SSC.
- The SLD 45 commander will be a one-star USSF general officer who will also be the director of the eastern range, the SSC operations director and the acquisition lead for the range of the future.
- Subordinate group-level organizations such as the mission support group and operations group at 30SW and 45SW are planning to inactivate, and units previously aligned under these organizations will look to realign under their respective Space Launch Deltas.
- The **45th Range Squadron** at Patrick SFB will be re-designated as the **1st Range Operations Squadron** and will transfer the airfield management and associated maintenance responsibilities and resources to the existing **45th Logistics Readiness Squadron**. The operational mission communications responsibilities and resources will realign from **45th Space Communications Squadron** to **1 ROPS**.
- The **Launch Enterprise** will be established as an office under SSC. The Launch Enterprise will realign under the SSC deputy commander.
- The manpower and funding of the **Air Force Research Laboratory** units that perform space science and technology functions will be under the administrative control of SSC, but will remain aligned to the AFRL commander for unity of effort. These units include Space Vehicles Directorate, Space Electro-Optics Division, Rocket Propulsion Division, and the Space Systems Technology Division.
- The **Strategic Warning and Surveillance Systems Division** will transfer from **Air Force Life Cycle Management Center** to SSC. The Division is the program office for ground-based radars, missile warning, space domain awareness, missile defense systems, and shared early warning capabilities.

- The **Space Force Commercial Satellite Communications Office** is currently aligned under SMC as approved under a previous organization change request and will remain aligned to SSC when it is established as a field command.

Additionally, SSC will provide select administrative and integration support to the **Space Rapid Capabilities Office** at Kirtland AFB, New Mexico, which is currently a direct reporting unit to the Chief of Space Operations. The Space Rapid Capabilities Office will receive their acquisition authorities from the Service Acquisition Executive.

Per the fiscal year 2021 National Defense Authorization Act, the **Space Development Agency** will transfer from the Department of Defense to the **U.S. Space Force** on October 1, 2022, as a unit aligning directly to the CSO.

Upon transfer, SSC will provide select administrative and integration support to SDA. The Space Development Agency will receive their acquisition authorities from the Service Acquisition Executive at that time.

The USSF organizational structure for echelons below the service headquarters is designed to support a lean, agile and mission-focused force. In order of hierarchy, the USSF field echelons are named field commands, deltas or garrisons, and squadrons.

There are three planned field commands aligned to specific mission focuses, of which SSC will be the second established.

The other two field commands are **Space Operations Command (SpOC)** and the planned **Space Training and Readiness Command (STARCOM)**.

SpOC was established on October 21, 2020, and is responsible for organizing, training, and equipping fielded space forces who execute space warfighting operations for combatant commanders, coalition partners, the joint force, and the nation.

STARCOM is projected to stand up in 2021 and will oversee training, education and professional development of units and personnel, doctrine development, and operational test of fielded systems.

The Space Force's new field structure effectively organizes space forces to fight in place within mission deltas.

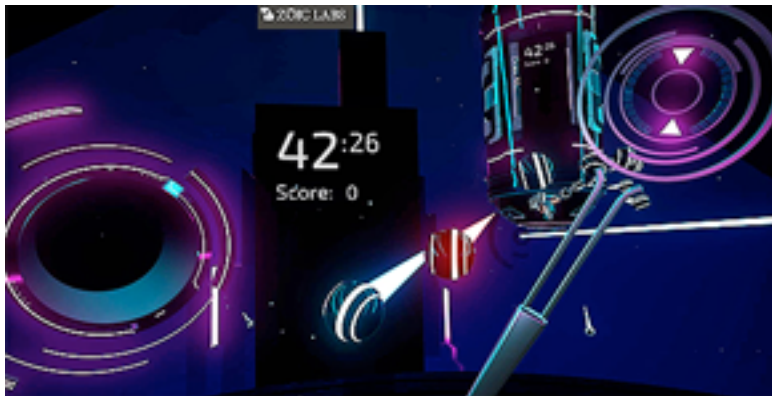
Installation support functions align under garrisons and look to use Air Force units and personnel through Air Force mission support groups, medical groups, and special staff.

## USSF SELECTS SLINGSHOT AEROSPACE FOR BATTLESPACE AWARENESS VISUALIZATION TOOL



**Slingshot Aerospace, Inc.** has been awarded a \$1.2 million contract to develop a sophisticated tool for the **U.S. Space Force (USSF)** that streamlines the visualization of enemy missiles and enhances data integration and mission-critical collaboration.

The company has partnered with Culver City, California-based, **Zoic Labs**, a software and advanced visualization company, to develop a video transcoder.



The new technology aims to enhance national security with advanced missile warning visualization by providing more efficient ways to view and interact with complicated data sets collected from satellite sensors.

These instruments, known as **overhead persistent infrared (OPIR) remote sensors**, use infrared radiation to visualize adversary weapons and assets. The Slingshot Aerospace tool has the following goals with respect to three missions:

- **Missile Warning** – Identify and characterize missile launches and communicate key information to appropriate stakeholders faster.



- **Technical Intelligence** – Help operators use OPIR data to detect, track, and characterize the adversary's assets.
- **Battlespace Awareness** – Carry out general surveillance to successfully apply combat power, ensure national security, and complete missions.

During the research and development phase, the Slingshot Aerospace tool will process archived data from space-based infrared systems. The controlled data sets will be used to develop and test algorithms and processing techniques, which will be evaluated and tested by end-users while in the prototype phase.

In the final step, the Slingshot Aerospace tool may be transitioned into real-world use for Air Force operators who are responsible for space-based infrared surveillance, tracking, and Missile Warning and Battlespace Awareness related reports.

Zoic Labs will be responsible for transforming satellite sensor data into video, storing a rolling cache, and publishing requested video content in a security camera-like format available for space operator use.

The Slingshot Aerospace tool will help operators identify threats and minimize false alarms. The solution will also lay the groundwork to support the *Department of Defense's* new, high-priority, missile warning satellite program, **Next Generation Overhead Persistent Infrared (or next generation OPIR)**. The U.S. government aims to launch these satellites in 2025.

*“The missile warning mission is critical for the United States to maintain superiority across all defense and intelligence domains. Our innovative solution will help improve the operator experience and optimize mission efficiencies, while positioning Slingshot Aerospace to be a potential leader in next generation OPIR situational awareness,”* said **Melanie Stricklan**, Co-Founder and CEO, Slingshot Aerospace.

*“Zoic Labs is thrilled to take on a critical component of this effort, converting satellite sensor data into actionable, decision-enabling information for our space warfighters and national security leadership,”* said **Tim McBride**, President of Zoic Labs.

## EM SOLUTIONS COMPLETES COBRA TERMINAL SHIPMENTS TO THE ROYAL AUSTRALIAN NAVY

EM Solutions, a wholly-owned subsidiary of Electro Optic Systems Holdings (EOS:ASX), has completed the shipment of the firm's final Cobra terminal for the Royal Australian Navy's (RAN) Anzac Class Frigates.

Witnessing the over-the-air test of the final and eighth Cobra terminal for the Navy's Anzac frigates was Chief of Navy, Vice Admiral **Michael Noonan**, AO and Dr. **Rowan Gilmore**, CEO, EM Solutions.

The Cobra is now used by the RAN on its Cape Class, Supply, Anzac, and future Arafura-class ships, as well as by five other navies around the world.

On the Anzac frigates, the Cobra will provide quality of life services to the crew and additional services to its existing legacy communications systems.

The Chief of Navy also inspected EM Solutions' expanded factory facility, which will accommodate the production of two much larger maritime communications terminals whose development is being sponsored by the RAN through the [Defence Innovation Hub](#).



Dr. Gilmore said, "The shipment of the eighth Cobra X/Ka-band terminal to the Australian Navy for each of its Anzac frigates marks an important milestone for EM Solutions. Since its commercialization through a Defence innovation grant in 2015, the Cobra has proven itself as an exemplar of a system that results from close collaboration between Navy end users, engineers, and industry. The support of the Navy throughout has been outstanding."



## LOCKHEED MARTIN SPACE LAUNCHES NEW ISR SATELLITES



**Lockheed Martin** (NYSE: LMT) has introduced a new line of rapid, integrated and affordable tactical *Intelligence, Surveillance and Reconnaissance (ISR)* satellites. These satellites, based on Lockheed Martin's **LM 400** mid-size bus, enable tactical warfighters to track moving targets at long ranges and operate in contested and denied environments — on compressed timelines at the scale of battle.

Based on flight-proven and mature components, an open architecture, and a highly produceable design, the affordable LM 400 satellite bus forms the backbone of this needed capability across a variety of emerging mission areas. These satellites fully integrate space ISR with the warfighting platforms and weapons of other domains to shorten the find-fix-finish kill chain.

The LM 400-based tactical ISR satellites offer the following benefits:

- *Interoperable: By following open standards, such as Open Mission System (OMS) and Universal Command and Control Interface (UCI), these tactical ISR satellites readily connect with other warfighting platforms and battle management systems from all services.*
- *Adaptable: The software-defined satellite capabilities of Lockheed Martin's SmartSat™ platform offer the ability to responsively develop and deploy new mission capabilities on orbit ahead of the pace of evolving threats.*
- *Powerful: The high-powered LM 400 can also support payloads up to 14 kilowatts and up to 3,300 pounds (1,500 kilograms) of mass, enabling extended operation of a wide-range of sensor technologies.*
- *Autonomous, Survivable, Combat-Ready: Powered by on-board processing and resilient connectivity, this tactical ISR satellite line enables in-theater, low-latency sensor tasking, on-orbit processing of mission data, protected communications and direct downlink of situational awareness and targeting information, increasingly*

*essential to shortening the sensor-to-shooter timeline against fleeting targets.*

For persistent ISR capabilities, “at scale” means larger constellations and rapid satellite production and deployment. Lockheed Martin’s new high-capacity Gateway Center satellite manufacturing facility supports accelerated space vehicle production, assembly and testing in a single, flexibly configured space, accommodating multiple security classification levels.

The LM 400-based tactical ISR satellites will play a key role in **Joint All-Domain Command and Control (JADC2)** by allowing tactical warfighters to better employ space-based capabilities. Lockheed Martin is also developing and building 10 space vehicles over the next two years for the **Space Development Agency's (SDA) Transport Layer Tranche 0**, cited as the backbone of JADC2, enabling even more connectivity between ISR and warfighters.

*“Digital engineering and manufacturing are accelerating our ability to deploy robust, future-focused constellations that feature leading-edge technology for our customers’ missions,”* said **Rick Ambrose**, executive vice president of Lockheed Martin Space. *“Our LM 400 is a highly adaptable, mid-sized satellite and yet can be produced at scale in a rapid and cost-effective manner.”*



## SPACE DEVELOPMENT AGENCY INITIATES RFI FOR MISSION-CAPABLE SPACE VEHICLES

**The Space Development Agency (SDA)** is seeking industry feedback on the design and development of mission-capable space vehicles for the *National Defense Space Architecture's (NDAS) Tranche 1 Transport Layer (T1TL)*, including feedback on industry’s ability to support a homogeneous constellation design to provide the full suite of Transport T1 capabilities.

T1TL will provide an initial warfighting capability through persistent regional access to low-latency data transport services. SDA expects the T1TL constellation to feature 6 near-polar circular planes with tens of satellites at 1000 km altitude in each plane.

All responses received to this Request for Information (RFI) are solely for information and planning purposes. Responses to this RFI may be used to support future solicitations.

Please see the RFI [at this direct link](#) for details and submission instructions.



## CONSTELLATIONS... ACCIDENTS WAITING TO HAPPEN? AN NSR REPORT...



Last week, two major constellations operators, OneWeb and SpaceX, nearly crashed in space, when two of their satellites almost collided. Another near-miss happened the same day when two other satellites nearly struck each other over the Arctic. And last month, the 2-ton NOAA-17 satellite broke up, sending dangerous debris all along its orbit.

This type of space debris and close calls are becoming too common, especially as more satellites are launched, and space junk, even from decades ago, persists and compounds the problem.

*Space Situational Awareness (SSA)*, the commercialized service of monitoring orbit and warning operators, maybe the best market response to this litter challenge. Yet, while the risk and opportunity grow daily, the SSA market lags.

Fractured coordination, capabilities, offering, and pricing structure, and long-established low priority affected to cleaning up space is such that SSA struggles as any emerging market does with a solid perception that “*if it ain’t broke, don’t fix it.*” Furthermore, it presents different views on the danger of debris, and the necessity of its services. Lastly, it suffers from far smaller funding and budget than is provided to constellations.



However, while constellations may appear crucial, especially to certain investment and bottom lines, SSA is, in fact, crucial to the safe and sustainable use of space to avoid constellations from becoming accidents waiting to happen.

Why is the SSA market lagging, what impact will that have on the industry, and what can be done to change the situation?

### **Government Play or Commercial Opportunity?**

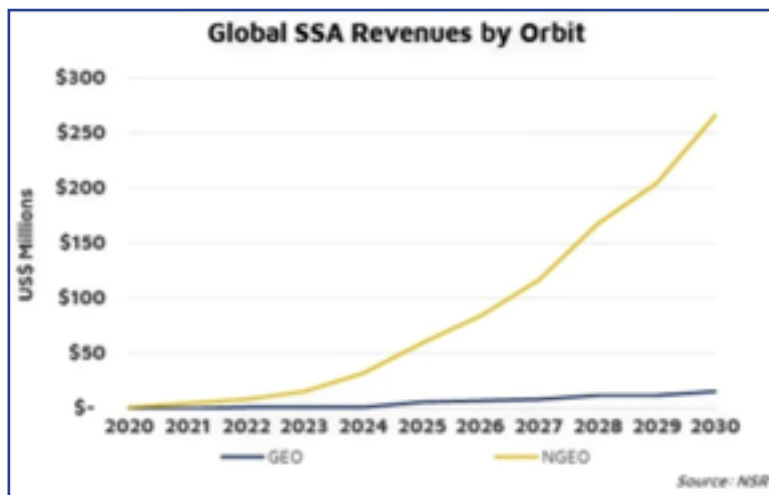
**NSR’s In-Orbit Servicing & Space Situational Awareness Markets, 4th Edition (IoSM4)** report forecasts SSA services to grow from just \$2 million to \$282 million in annual revenues between 2020 and 2029. While that seems impressive, NSR also forecasts that SSA players will only capture 20% of the serviceable addressable market during that time. In other words, **out of every five high-risk satellites operating over the next decade, only one will be actively monitored and tracked**, with warnings provided to its operator by a commercial provider.

Competition with government programs is one reason behind this trend. Increased funding and development of programs, such as the *U.S. Space Fence*, *JAXA’s SSA*, and the *EU Space Surveillance & Traffic (EUSST)* will challenge the commercial market through the capabilities and services offered. Additionally, the issues of dual-use, and splitting between classified and non-classified data, muddy the water and are expected to limit the commercial play. However, given the high-strategic value of the assets, government and military customers are still expected to drive commercial SSA market revenues, at 53% of the cumulative opportunity over the decade, 95% of which will be for non-GEO satellites.

While growing government programs will bring greater monitoring capability, a severe lack of coordination and fragmentation of performance hold the SSA market back, at best, and spell disaster for operators in the worst case.

### **Worst Case Scenarios**

Take the OneWeb/Starlink near-collision. According to one report, the **U.S. Space Force** alerted *OneWeb*, who then contacted *Starlink* to quickly create a mitigation plan. For a reason yet unknown outside of *SpaceX*, the company turned



off its automated collision avoidance system, allowing OneWeb to take full control of the situation by maneuvering their satellite away. There was no pre-arranged plan, and coordination was handled last minute.

There is no central governing authority for SSA or satellite collision avoidance. Licensing regulations remain fragmented, region to region, and underdeveloped, failing to set minimum required capabilities and standards.

While it is generally imprudent to fear that the sky is falling, these incidents will continue, in greater frequency, and one day, the worst-case scenarios will unfold, and collisions will happen. In the meantime, late coordination costs money, through reactive avoidance maneuvers, shortening satellite and revenue-generating lifetimes.

There is hope here. Support for SSA coordination has grown, such as through statements made recently by the **U.S. Space Command** who support setting international “rules of behavior in space”. At the same time, projects such as *IBM’s SSA*, and *Imagine LAB’s Eyes on the Sky* projects are aiming to crowdsource and coordinate the development of SSA data and monitoring capabilities. In the commercial sector, partnerships such as between *LeoLabs* and *SpaceX* serve to support and improve the development of SSA services.

Space is full of junk. Debris, defunct satellites and other objects like rocket bodies as far back as from the first few rocket launches remain a danger in orbit. With constellations continuing to drive the market, the chances of collision will only increase.

Space Situational Awareness is necessary for monitoring and warning against this risk, yet the capabilities and market remain significantly fragmented and underdeveloped. Coordination, collaboration, and setting stronger standards for collision avoidance will be necessary to move this market forward. *Otherwise, collisions, not constellations, will be the main market outcome.*

*Author: Dallas Kasaboski,  
Principal Analyst, NSR*



## EUROCONSULT SMALLSAT MARKET REPORT UPDATED

The latest update of “[Prospects for the Small Satellite Market](#)” has been published by [Euroconsult](#), forecasting further growth in the global supply and demand of government, commercial and academic satellites weighing up to 500 kg.

The market intelligence report, now in its 7th edition, builds upon Euroconsult’s previous iteration that accurately predicted more than 1,000 satellites would be launched during 2020, a record year despite COVID-19. The new release further reinforces the sentiment that the 2020s will be the decade of small satellites, anticipating the launch of close to 14,000 smallsats before 2030.

The main driver for this continued growth during a time where many face pandemic-related challenges is plans for SATCOM broadband “mega-constellations” and the continuous necessity for replenishment launches. Of all smallsats to be launched, 84% are expected to be part of constellations.

Furthermore, the smallsat manufacturing and launch market are set to do more than triple over the next decade, to \$35 billion and \$19 billion respectively, driven by the multiplication of constellation projects from both commercial and government stakeholders.

Euroconsult, who operates from locations across North America, Europe and Asia and specializes in the space sector and satellite enabled verticals, have released their updated findings at a time when launch rates are at least on par with last year, suggesting that the era of the mega-constellation has truly arrived.

Flagship examples of LEO broadband constellations, such as *SpaceX’s Starlink* and *Amazon’s Kuiper*, account for almost half of the projected demand over 2021-2030. Readers are therefore advised to go beyond raw numbers as vertical integration keeps growing with numerous players seeking to manufacture, operate and launch their own smallsats.

Significant future market shares are now captive of a region, country or of an integrator and/or launch provider, challenging both commercial satellite integrators and launch providers which see more of their target customers not only leaving their addressable market, but also competing with their own services. The smallsat market is, however, more open to procurement from third parties at the subsystem level than at the satellite level.



The updated report, free extract available, comes with an option to access premium features, including Euroconsult’s *Smallsat Constellation Database* that covers extensive past, current and future data – the first time Euroconsult have ever shared their “secret ingredients” with customers.

[A free report abstract is available at this direct link...](#)

*Alexandre Najjar*, Senior Consultant at Euroconsult stated, “Our smallsat report is once again in high-demand and with major intelligence updates being drawn from post-pandemic data and reviews of key pricing models and SATCOM application forecasts, plus the inclusion of Space Logistics information that features In-Orbit Servicing, Debris Removal, Last Mile Logistics and In-Orbit Manufacturing, we believe this report will be invaluable to key industry stakeholders and investors. A plethora of new market insights include the mitigation of concerns around the impact of COVID-19 in our previous edition by an increased availability of capital for the space sector, most notably with the recent M&A and SPAC funding trend.”

Other valuable updates to *Prospects for the Small Satellite Market* include a reviewed and refined pricing model for manufacturing and launch prices, while satellite applications in the database have been rebalanced, most notably with regard to Information, Earth Observation (EO) and Security applications.

The Euroconsult report incorporates new content to help give decision makers key knowledge in this area, as well as a reviewed and up-to-date forecast accounting for the economic situation and impact of COVID-19.

With its increasing importance, the extensive Euroconsult database has been updated to reflect the significant growth and developments of the Chinese constellations, with input from Chinese-speaking stakeholders.

This publication includes extensive data points on units, mass, and value for manufacturing and launch services. It provides a forecast for the next decade broken down by application, orbit, operator type, mass category, operator region, as well as integrator and launch provider, type of integrator, type of launcher and other subsets.

This report has now been added to the Euroconsult shop alongside a portfolio of high-demand space sector research that includes the 24th edition of *Satellites to be Built & Launched* and the 8th edition of Euroconsult’s *Space Economy Report*.

All Euroconsult reports are available for purchase through the firm’s online infosite [at this direct link...](#)

**AEROSPACE UK LTD'S £500K  
CONTRACT WITH UK MINISTRY OF  
DEFENCE SPACE DIRECTORATE**

The [Aerospace Corporation](#) (Aerospace) recently announced that their wholly owned U.K. subsidiary, [The Aerospace Corporation UK Ltd \(Aerospace UK\)](#), has secured a one-year contract for £500,000 to advise the [U.K. Ministry of Defence \(MoD\) Space Directorate](#) on a decision-making framework for space capabilities.

*"Space is critical to securing operational advantage and enabling multi-domain integration: It is the responsibility of my team to deliver space coherency across defense and ensure we are aligned with other Whitehall Departments,"* said Air Vice Marshal (AVM) [Harv Smyth](#), Director of Space at the MoD. *"Whilst we are the single touch point for space in defense, this is a team effort, and we are delighted to be working with The Aerospace Corporation UK Ltd, whose expertise over many years spans the entire space enterprise."*

Aerospace UK will help to address the MoD Space Directorate's challenges, in parallel with U.S. Space Force Chief of Space Operations Gen. [John W. "Jay" Raymond's](#) *Planning Guidance* objective to strengthen the space capabilities of U.S. allies.

*"Working with our allies directly, and through common mission partners, we strengthen our mutual ability to rapidly deliver war-winning capabilities,"* said Lt. Gen. [John Thompson](#), Space and Missile Systems Center commander.

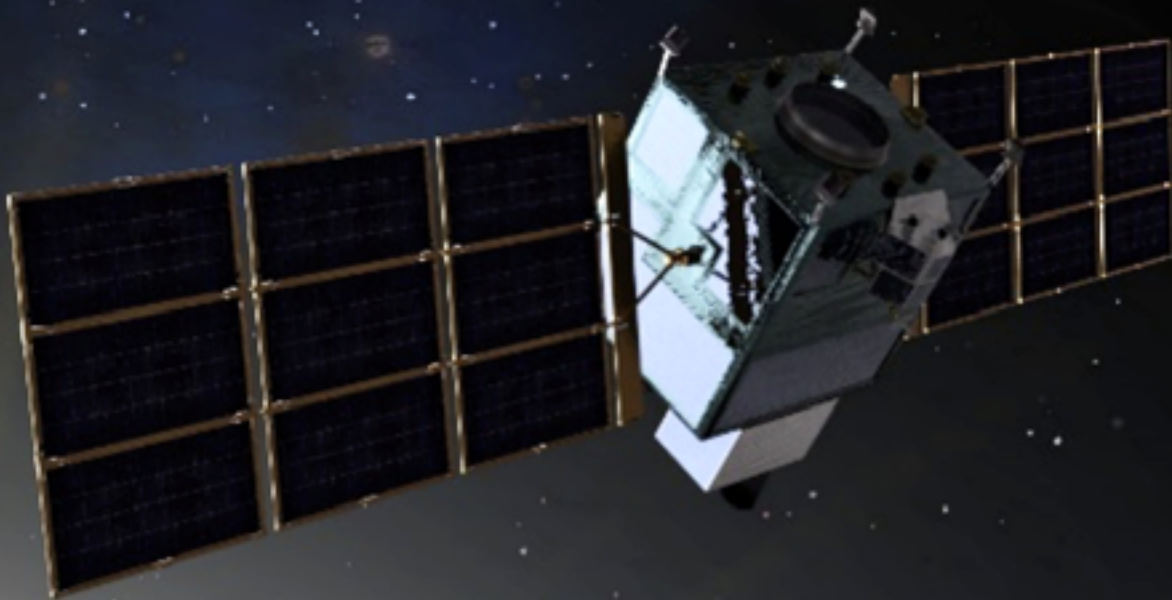
*"As the United Kingdom stands up their new Space Command and embarks on their first national space strategy this year, we are excited to work alongside our longest ally to deepen these ties. Through U.K.-U.S. efforts like International Space Pitch Days and collaborative exploration of how to integrate our complementary space systems together, our mission partners help us collectively deliver coalition capabilities that will outpace the threat."*

In its March 16 *Integrated Review of Security, Defence, Development and Foreign Policy*, the U.K. established that it views space as fundamental to the delivery of military capability and to the functioning of wider society. As access to space is increasingly congested and contested, the MoD is developing space capabilities and infrastructure that will enable the U.K. to continue to operate effectively in a degraded or denied space environment. Effective strategic planning underpins the MoD's response to the evolving space security environment.

*"Space is a complex and expensive environment, and we understand the dedication and collaboration required to achieve success,"* said [Gina Galasso](#), Aerospace U.K.'s managing director. *"We are excited to be working with AVM Smyth and his team to help them develop and deliver space capabilities necessary for their protect-and-defend mission."*

# SPACE & MISSILE SYSTEMS CENTER FEATURE

## NEXT GENERATION OPIR POLAR SATELLITES TO PROVIDE ENHANCED MISSILE WARNING CAPACITY TO THE ARCTIC REGION



THE SUCCESSOR TO SBIRS INCLUDES IMPROVED  
GROUND CONTROL SYSTEM, FORGE.



*Rendering of the Next-Gen OPIR Polar satellite in the deployed  
configuration with a view of the North Pole and key threat regions.  
Image is courtesy of Northrop Grumman*

**Increasing international military activity and interest in the Arctic calls for improved monitoring, and the Space and Missile Systems Center is working to deliver the next generation of missile warning satellites.**

The *Next-Gen Overhead Persistent Infrared (OPIR) Polar Constellation*, which will be operational by 2030, consists of two polar-orbiting missile warning systems built by **Northrop Grumman Space Systems**. The constellation is part of the survivable, resilient Next-Gen OPIR architecture and ensures full missile warning coverage of the arctic.

The Next-Gen Polar satellites will provide unblinking missile warning capability over the Arctic region and offer significant battlespace awareness and technical intelligence capabilities. It's one of the critical mission areas of the **U.S. Space Force**.

"The increasingly contested nature of space makes it imperative that we continue to intensify the resiliency of U.S. space-based capabilities," said Lt. Gen. **John F. Thompson**, SMC Commander and Program Executive Officer for Space. "To that end, we are partnering with the Space Development Agency (SDA) and the Missile Defense Agency (MDA) to transform our missile warning/missile tracking architecture, prototyping efforts across multiple orbits and proliferated constellations."



Lt. Gen. John F. Thompson

Thompson added, "Working closely with our mission partners ensures we're addressing the threat. We're assuring clear lines of effort to maximize technological innovation and prevent overlap. Further, our Next-Generation OPIR program will serve as the backbone of our missile warning architecture to assure this critical and dominant capability into the future."



Col. Daniel T. Walter, Next-Gen OPIR Program Manager at SMC

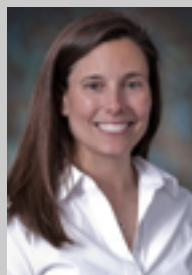
"People often ask what is so hard about this mission," said Col. **Daniel T. Walter**, Next-Gen OPIR Program Manager at SMC. "Detecting a missile is not the most difficult thing we do. The challenge is ensuring we never get one wrong; never have a false positive and never miss one. We can never wake up the president with a false alarm and we can never miss a missile that's being fired upon us or our allies. We take our mission extremely seriously."

What makes this new constellation "next generation" is that it will augment, then eventually replace, the **Space Based Infrared System (SBIRS)**, a series of satellites in Geosynchronous Earth Orbit (GEO) and sensors hosted on other satellites in *Highly Elliptical Orbit (HEO)*. The first of this constellation was launched in 2011; two additional GEO satellites will be launched, one this year and one a year later.



Artistic rendition of the Space-Based Infrared System (SBIRS). Image is courtesy of Lockheed Martin.

"Unlike the SBIRS HEO satellites, the Next-Gen OPIR Polar satellites will be "free flyers" — not hosted on another satellite's payload — and Northrop Grumman has leveraged the enhanced payload capacity to improve performance and resilience," said **Sarah Willoughby**, Vice President, Northrop Grumman for that firm's OPIR and Geospatial Systems Business Unit.

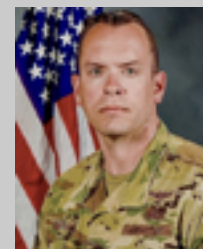


Sarah Willoughby, Vice President of OPIR and the geospatial systems business unit for Northrop Grumman and Program Manager for Next-Gen OPIR Polar

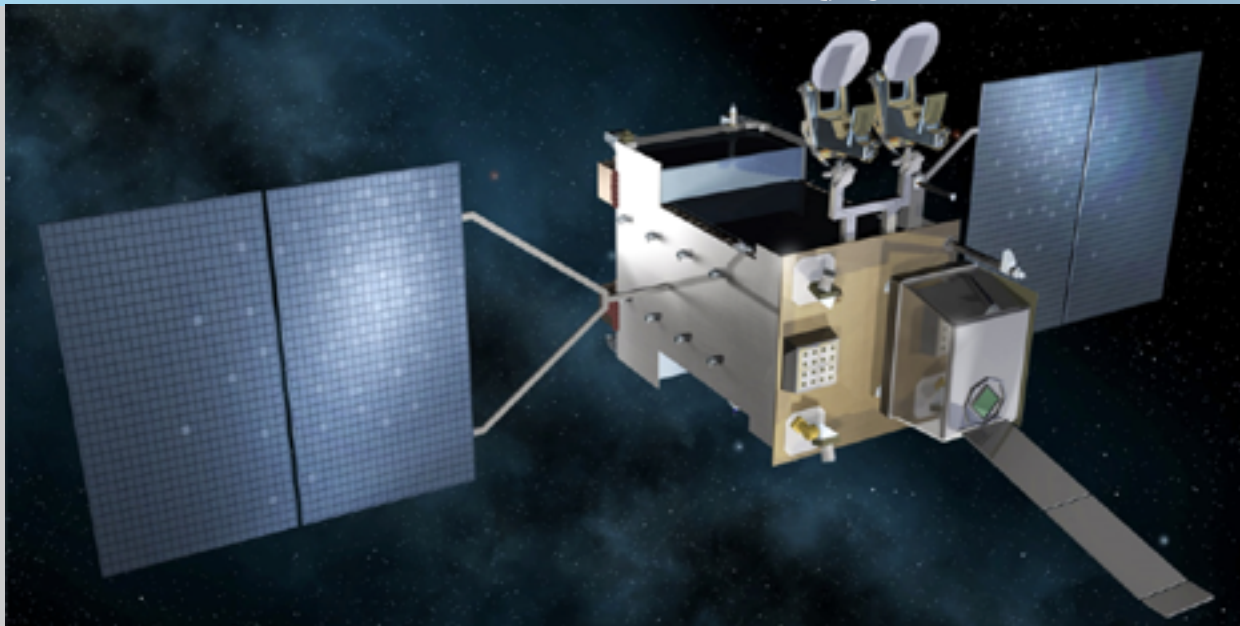
She noted, "In the context of the evolving and emerging threat, these polar satellites are in the fight as you consider the potential extension of conflict into the space domain. We really will have improved coverage of the northern hemisphere. We compliment GEO coverage and it gives us flexibility as conflict escalates to ensure that we have the missile warning coverage and can supply OPIR data to the command and to the warfighter."

In addition to the two Polar satellites being built by Northrop Grumman, **Lockheed Martin** is building three, Next-Gen OPIR satellites for a geosynchronous orbit.

"There are a number of critical capabilities that make these assets unique," said Lt. Col. **Josh Wehrle**, Materiel Leader, Next-Gen OPIR – Polar, for SMC. "The Next-Gen OPIR Polar and GEO satellites have greater sensing capability than our current constellation to better detect the growing arsenal of missiles across the globe. They also have better capability to



Lt. Col. Joshua Wehrle, Materiel Leader, Next-Gen OPIR – Polar, Space Development Corps at SMC.



Artistic rendition of the Next-Gen OPIR GEO satellite.  
Image is courtesy of SMC

adapt to operate through multiple threats that seek to deny our ability to operate.”

He noted, “SBIRS and Next-Gen OPIR support four mission areas: missile warning; supporting missile defense; battle space awareness and technical intelligence – providing the intelligence community, combatant commanders, and senior leaders with information from space.”

For SBIRS HEO, SMC developed a sensor and integrated it as an auxiliary payload on a host satellite. For Next-Gen OPIR Polar, SMC is acquiring the entire space vehicle so the government can specifically address mission resiliency, Walter said.

“The counter-space threat has evolved, and we’ve deliberately designed these satellites to ensure they can counter the broad range of adversary threats,” Walter said. “Secondly, the targets have gotten harder and we have more capacity in our sensors (with Next-Gen OPIR) to be able to detect and report on a broader range of globally available missiles.”

“The Next-Gen OPIR Polar effort is a result of the U.S. Space Force leaning forward and adapting to new and emerging threats,” Wehrle said. “Our adversaries are not slowing down development; the U.S. Space Force (USSF) and U.S. Department of Defense must ensure we maintain an asymmetric advantage. That is the purpose of the Next-Gen OPIR: adapt, and emerge ahead of the threat.”

“Its primary job is to watch the cold background of the Earth’s surface and look for any ‘hot’ spots,” Walter explained. “Any time a hot spot is detected, the sensor will process it and make sure it’s capable of identifying it either as a missile or something else.”

Polar orbit satellites typically launch from **Vandenberg AFB**, fly down over the South Pole and then up to cover the North Pole, Walter said. One issue with the GEO “look angle” is that they don’t have the best angle to see the North Pole. A HEO orbit provides better coverage.

“Our allies have a high degree of dependence and reliance on the missile warning capability of DSP, SBIRS, and Next-Gen OPIR,” Walter said. “While we are the ones developing and ensuring it’s going to be launched, all of our partner countries benefit from the missile warning information that it generates.”

“SMC is also developing a ground system that will eventually process data not only from SBIRS, but also from Next-Gen OPIR satellites – Future Operationally Resilient

Ground Evolution, or FORGE,” said Lt. Col. **Eric Reinhart**, Chief of Missile Warning Capability Area Integration at SMC. “FORGE will not only be able to work with SBIRS and Next-Gen OPIR, but because it uses an open, scalable, and modular architecture, its adaptability will allow it to support a variety of space-based Missile Warning and Missile Tracking assets long into the future.”

He added, “Many think of it as similar to an Apple iPhone – FORGE is a platform that can easily host the various apps needed to support multiple sensors whereas the current SBIRS ground system requires much more of an effort just to support one new sensor. FORGE is an open architecture.”

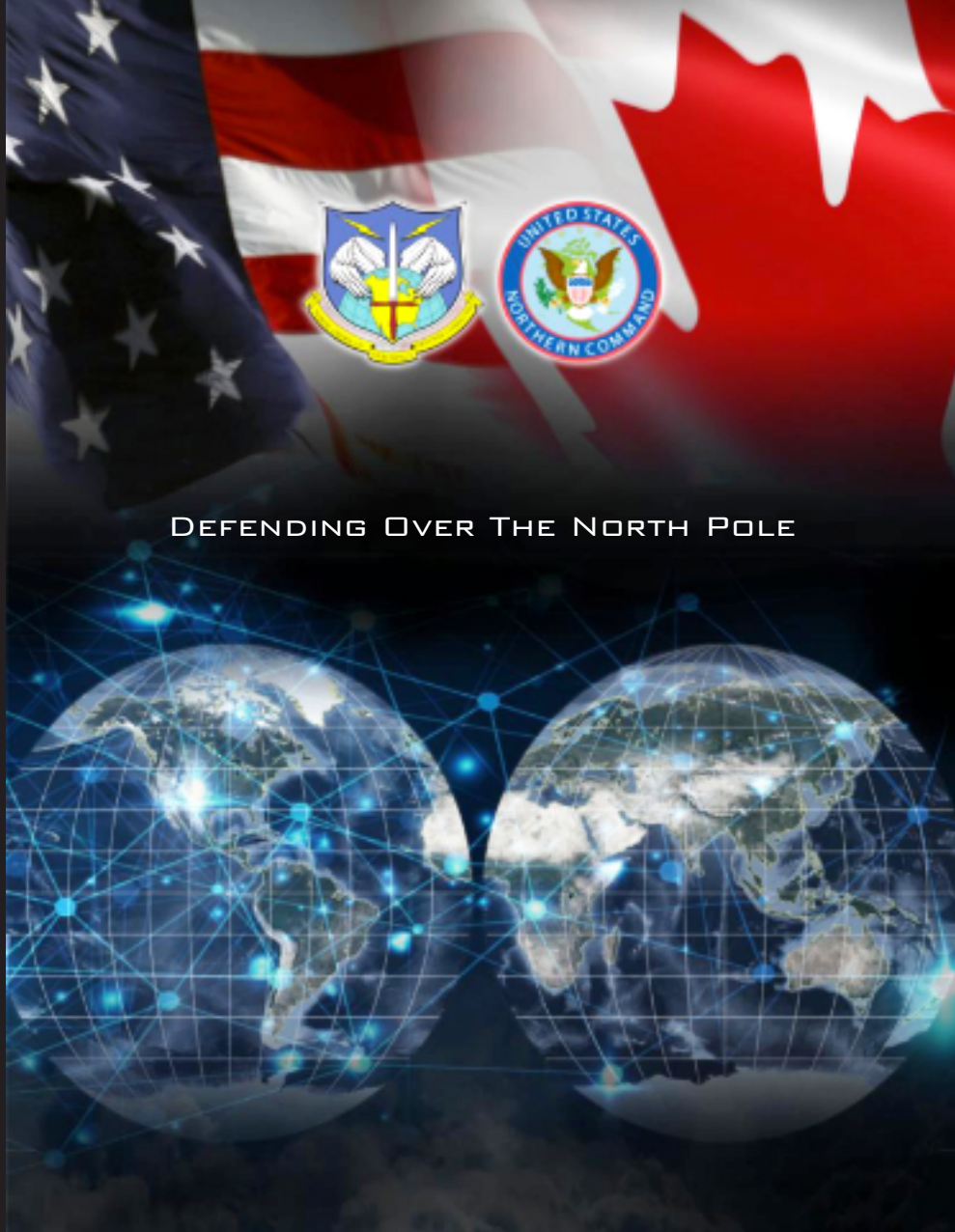
“FORGE is the future common denominator of the current SBIRS constellation and the Next-Gen OPIR system, and the future capability that will augment the entire OPIR architecture,” Wehrle explained. “Without FORGE and the team of professionals working on the ground, our satellites, no matter how technically capable they are, have no way delivering critical data to the network of users and warfighters.”

Reinhart said SMC is working with MDA, SDA and other agencies to define what the Missile Warning and Missile Tracking architecture beyond Next-Gen OPIR will look like.

“You have to continue planning this work years in advance,” Reinhart said. “We’re already looking at the architecture beyond Next-Gen OPIR, which takes us to the year 2030 plus. You have to continue to refine and look at how you’re going to advance the mission area. Introducing new technologies – at the right time – is important as we continue to advance our capabilities.”

The USSF’s Space and Missile Systems Center portfolio includes space launch, global positioning systems, military satellite communications, a defense meteorological satellite control network, range systems, space-based infrared systems, and space situational awareness capabilities.

Contact Space & Missile Systems Center at [SMC@Spaceforce.mil](mailto:SMC@Spaceforce.mil) and follow us on [LinkedIn](#).



## DEFENDING OVER THE NORTH POLE

*The Arctic region is critical to U.S. national security and the defense of not only the United States, but its allies, with the U.S. Air and Space Forces providing most of U.S. Department of Defense resources to that region.*

*U.S. Air and Space Force assets in the region include two Alaskan air bases — [Joint Base Elmendorf-Richardson](#) and [Eielson Air Force Base](#), and other strategic facilities.*



*There is also the Alaska Radar system and the more than 50 radars that comprise the North Warning System across Canada operated by the [North American Aerospace Defense Command \(NORAD\)](#), a joint U.S. and Canadian effort that provides aerospace warning, air sovereignty and protection for North America.*



*“The Arctic region has always been important,” said Col. Daniel T. Walter, SMC Next-Gen OPIR Program Manager. “And, as climate change introduces more commercial shipping traffic into the Arctic, polar monitoring becomes more vital.”*

*“All the more reason that it’s the best mission from space,” Walter said. “It’s hard to have and maintain a global cost-effective ground-based architecture. From space – from the ultimate high ground – we’re able to do these missions very well.”*

*Over the North Pole is often the quickest route for the United States to reach a number of regions around the globe — and vice versa — and preserving that access for the U.S. and its allies is another reason why the Arctic is so critical to U.S. interests, said Lt. Col. Eric Reinhart, Chief of Missile Warning Capability Area Integration at SMC.*

*“It’s not just security interests that are critical in the Northern Hemisphere – there’s a threat to U.S. economic interests as well,” said Lt. Col. Josh Wehrle, Materiel Leader, Next-GEN OPIR, Polar for SMC, noting the Arctic oil and gas reserves.*

The shipping routes comprising the Northeast Passage, Northwest Passage and Central Passage that cross the Arctic Circle and connect the three economic centers of North America, East Asia and Western Europe are dubbed the "Polar Silk Road." This is a 25 percent shorter route for China than via the Suez Canal and China has increasingly sought to increase its influence in the region, Wehrle noted.

According to North American Aerospace Defense Command's (NORAD) Arctic Strategy, both Russia and China are increasingly active in the Arctic: "Russia's fielding of advanced, long-range cruise missiles capable of being launched from Russian territory, flying through the northern approaches, and seeking to strike targets in the United States and Canada has emerged as the dominant military threat in the Arctic.

"Additionally, diminished sea ice and competition over resources present overlapping challenges in this strategically significant region. China is not content to remain a mere observer in the growing competition, declaring itself a 'near-Arctic state,' and has taken action to normalize its naval and commercial presence in the region to increase its access to lucrative resources and shipping routes."

In testimony before the Senate Armed Services Committee in March 2021, U.S. Air Force Gen. Glen D. VanHerck, commander of the U. S. Northern Command (USNORTHCOM) and NORAD, said U.S. and Canadian armed forces were in the early stages of modernizing NORAD and building additional military capabilities in the Arctic.

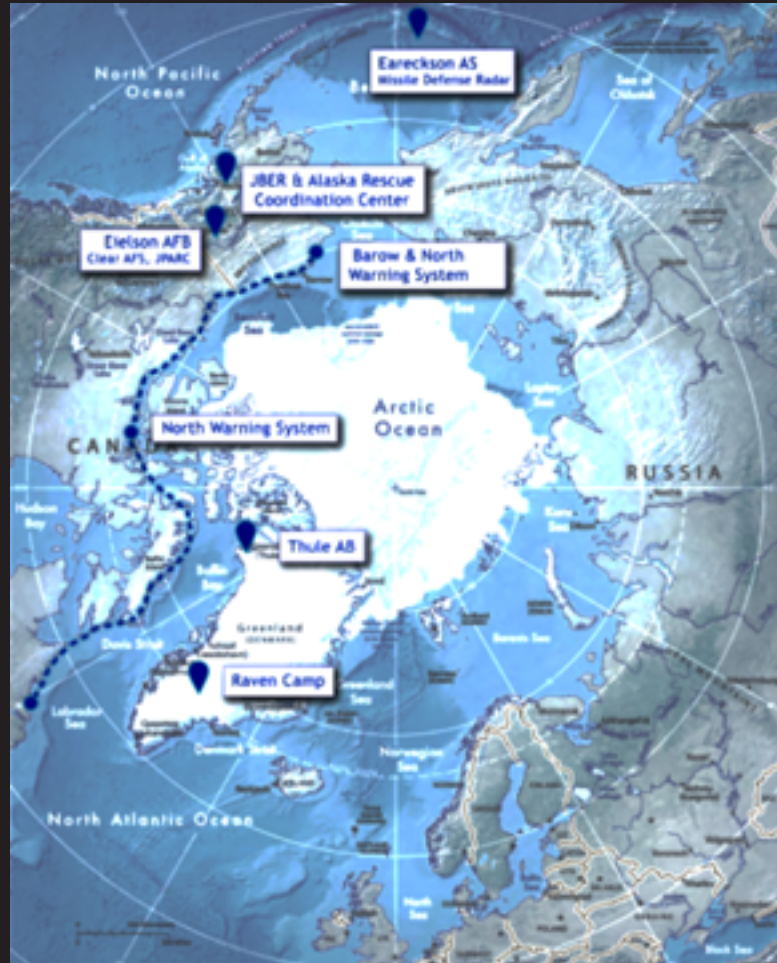


Gen. Glen D. VanHerck, Commander, United States Northern Command and North American Aerospace Defense Command

"In coordination with the Missile Defense Agency, the United States Strategic Command and USSPACECOM, we're maintaining and improving upon our ballistic missile defense capabilities," VanHerck said. "We're placing significant emphasis on a left-of-launch framework that will provide decision space for our senior leaders, enabling deterrence and de-escalation options vice end-game defeat."

"We're advocating for investment in all-domain awareness to generate a layered sensing grid and a layered defense approach that emphasizes the use of an open-sensor data architecture and machine-enhanced processing in order to achieve information dominance and decision superiority," VanHerck continued. "Through these efforts, we will grant decision-makers the increased decision space and build upon flexible response options to deter, deny or defeat every threat to the United States and Canada."

Currently, NORAD and USNORTHCOM have the capability to defend the continental United States and Hawaii against a limited number of missiles from North Korea, VanHerck said. However, capacity will be the most pressing issue in the future.



The Arctic region is home to eight nations and is strategically important to the United States and its allies. Shown here are just a few of the military resources operated by the U.S. Department of the Air Force.

**What is the Arctic Region?**  
 An area more than twice the size of the continental United States, which includes the Arctic Ocean, adjacent seas and parts of eight countries:

The United States	Canada
Finland	Iceland
Norway	Russia
Sweden	Kingdom of Denmark, including Greenland

According to the [U.S. Department of the Air Force Arctic Strategy](#) the North American Arctic has a much harsher environment than the European Arctic, and little highway and maritime infrastructure.





# MILSATCOM INNOVATIONS

AN UPDATE ON IDIRECTGOV'S PLANS FOR 2021

Author: Karl Fuchs, Senior Vice President of Technology, iDirect Government,  
and MilsatMagazine Senior Contributor



## We are a quarter into the new year; what will iDirect Government (iDirectGov) engineer to benefit the warfighter, government and civilian agencies this year?

We are on a fast track to substantial innovations that will emerge this year in security and transformation in a "Defense-in-Depth" approach to secure SATCOM. Our **Evolution™ 4.2.2.0** will serve as the foundation for our growth.

The MILSATCOM software already integrates our *Communication Signal Interference Removal (CSIR™)* technology into the company's **9-Series** modems.

The question now is, what other technologies can be leveraged to provide an even faster and more secure satellite communications solution?

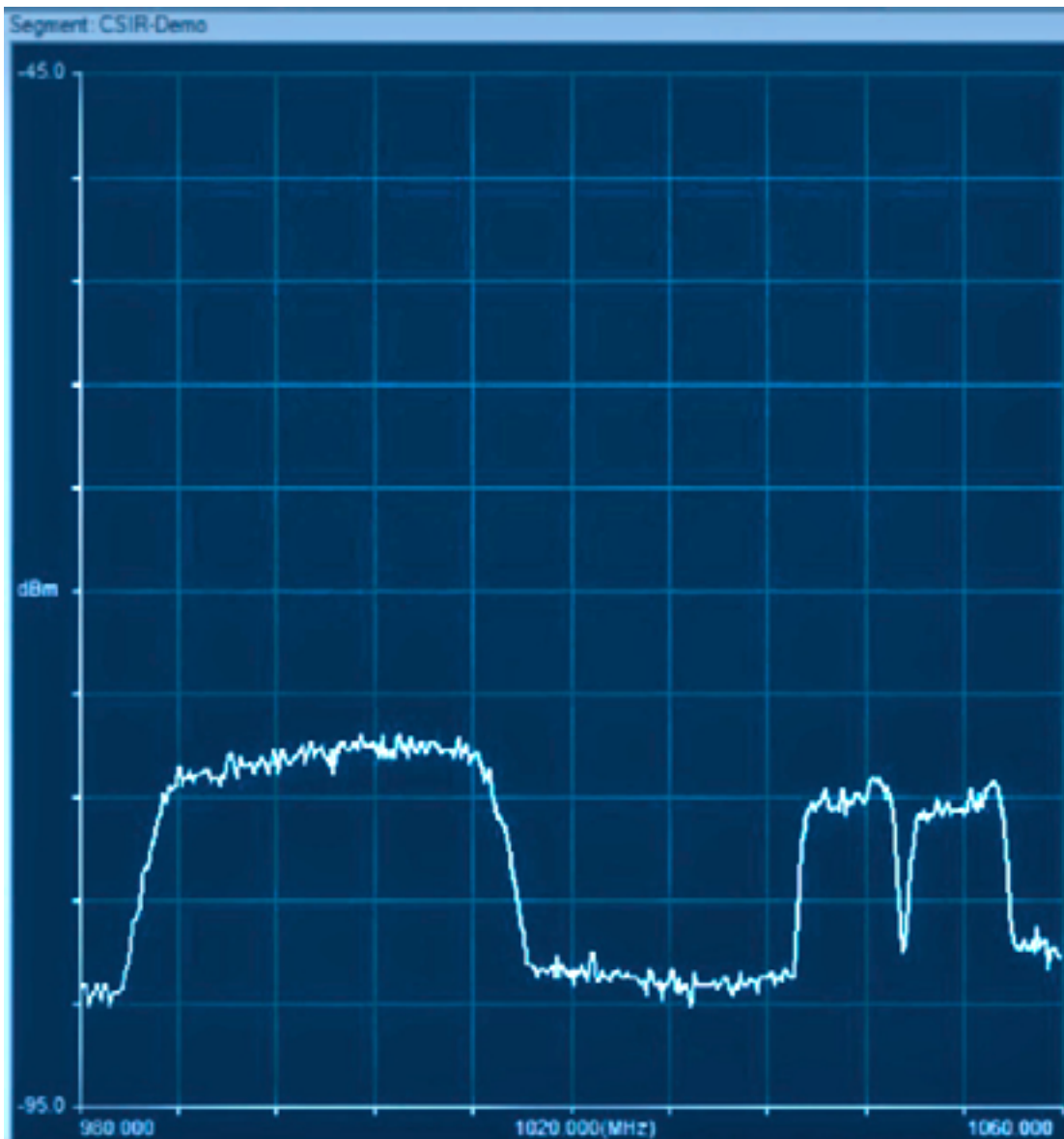
Users in the *Department of Defense (DoD)*, homeland security and first responders currently implementing iDirectGov's 4.2.2.0 have embraced a system that allows them to plan, detect, locate, remove, report and deploy mitigation to signal interference if needed. Therefore, this approach means if one mechanism fails, another checkpoint is ready to impede an attack.

This year, our *Technology Innovation Department* is exploring taking CSIR technology one step farther by incorporating it into other non-iDirect Government RF equipment that includes HF radios, GPS antennas and numerous other potential use cases, all to benefit the U.S. DoD in its efforts to combat interference, whether the obstruction be blue on blue or red on blue.

Building upon Evolution™ 4.2.2.0 success, iDirectGov's 2021 development addresses specific end-user needs.

The cornerstones of the 2021 development include the following:

- *Electronically Steerable Antennas (ESAs) modem integration*
- *Multi-Orbit Support*
- *Anti-Jam Low Probability of Interception (LPI) / Low Probability of Detection (LPD)*
- *Low Probability of Detection*



### ELECTRONICALLY STEERABLE ANTENNAS INTEGRATION

There exists a great need for compact ESAs that can perform in high-channel bandwidths such as *High Throughput Satellite (HTS)*, among others. ESAs address the mobility needs of our troops in the field and government agencies.

The military's widespread use of intelligence, surveillance and reconnaissance (ISR) missions and other full-motion, high-definition video feeds warrant ESAs. These are the fastest-growing and bandwidth-consuming applications used by the warfighter.

Consequently, to address this need, we will introduce a new remote with a radically new design concept. The new modem will be ideally suited for airborne, drones and directly embedded into antennas.

Unlike previous modem designs, this design will "de-couple" the analog and digital portions of the modem and use industry standard interfaces. This will provide ESA manufacturers with the flexibility to directly integrate the modem's digital and analog sections separately--and in any configuration that best suits their specific applications.

This design eliminates such concerns as cable bend radius and interface placement, which have plagued terminal manufacturers in the past. Features such as automatic loopback, signal integrity tests and spectrum analysis tools will be built into the modem. This will enable ESA manufacturers to produce an excellent product for high-speed connectivity in a mobile environment.

## MULTI-ORBIT SUPPORT

We will continue development on a new hub platform that suits the operational characteristics of *Low Earth Orbit (LEO)* and *Medium Earth Orbit (MEO)* satellite constellations.

The new hub will address the make-before-break for satellite hand-off and remote acquisition while maintaining the strict obfuscation of traffic engineering information required by *transmission security (TRANSEC)*.

In addition, this hub platform will have the processing power and symbol rates needed to enable new anti-jam and LPI/LPD innovations.

## ANTI-JAM

We have seen a steady increase in adversaries' sophistication for monitoring MILSATCOM, initiating cyber-attacks, jamming transmissions over geosynchronous satellites. The rate of both "red on blue" and "blue on blue" interference events are rising dramatically.

Although *electromagnetic interference (EMI)* has always existed, the sheer number of new satellites being launched and the encroachment of 5G frequencies into satellite bands are driving a dramatic increase of "blue on blue" interference incidents. To this end, iDirectGov has taken a multi-phased approach to anti-jam.

**Phase 1** involves the implementation of CSIR signal excision technology. This technology is exceptionally robust and can mitigate a wide range of interferer types. It does not rely on spread spectrum, so it requires no additional bandwidth.

Signal excision technology such as CSIR is a vital component to a full anti-jam solution because jamming threats exist even when there may not be sufficient bandwidth available to employ traditional anti-jam technologies such as spread spectrum.

CSIR technology effectively mitigates a wide range of interferers. Testing and deployed systems show effectiveness against *carrier waves (CWs)*, modulated carriers, sweeping tones, multiple CWs or combs, hopping carriers and a combination of multiple threats.

## Cornerstones of iDirect Government's 2021 Roadmap

- **Electronically Steerable Antennas (ESAs) Modem Integration**
- **Multi-Orbit Support**
- **Anti-Jam**
- **Low Probability of Interception (LPI) / Low Probability of Detection (LPD)**

Currently, this technology is available as either a stand-alone box or integrated into our 9-Series modems. By integrating this technology into our modems, we are continuing to enhance our SWaP capabilities by providing the option of eliminating an additional box.

**Phase 2** will expand on the SWaP improvements in Phase 1. Phase 2, expected in Q4 of this year, will include the integration of CSIR technology into our *Defense Line Cards*.

Through this integration, CSIR signal excision is now embedded into our line cards, providing protection on both the send and receive chain without the need for an additional piece of hardware at the hub side.

## FUTURE PHASES

In addition to the acquisition of *Glowlink* and the subsequent merger of its CSIR technology into our 9-Series modems, we acquired additional technologies that, when combined with CSIR, will have an even greater impact on our interference removal and jamming strategies.

It is too early to disclose the technology details as we are still in the development and test phase. Initial testing, however, has shown incredible results in speed and efficiency.



Rounding out our 2021 development plan is **LPI/LPD**. This fourth cornerstone is critical to provide communications stealth for special operations and other key users as stealth technology has proven to be a decisive factor in many battle scenarios.

A significant portion of LPI/LPD work is classified, therefore, not much can be divulged. However, all the development in our new remote portfolio and our next-generation hub is leading us to a stealth solution as covert communications are essential to our warfighters.

Although these four cornerstones constitute our main development drivers, work on other enablers continues. iDirectGov remains focused on improving our security posture with operating system vulnerability scans.

We are developing a fourth generation of our TRANSEC to improve spectral efficiency and virtualization, enabling a cloud architecture for our hub.

## CUSTOMERS FIRST

Throughout our development, our mantra to “listen to our customers” paves the way for our MILSATCOM solutions going forward. We remain actively engaged with our end-users and understand what is important to them in secure communications.

We will work very closely with our end-user communities to directly understand what their needs are, how they are going to use technology and what is important to them. This holds for end-users and intelligence organizations.

Our talented engineering team has direct experience with the U.S. Military, Allied Special Forces and other defense operations, offering insider insights into development.

This field experience is absolutely vital when it comes to building for military sectors. Not all companies delivering to defense markets understand this practice, but we consider it our hallmark to have first-person understanding. We believe this cannot be matched.

## IN PERSPECTIVE

No matter what the coming 2021 year brings, one reality is certain: Defense-in-Depth is not going away. Layers of MILSATCOM security will continue to be added to keep our warfighters safe.

[www.idirectgov.com](http://www.idirectgov.com)



*Author Karl Fuchs is the Senior Vice President of Technology at iDirect Government (iDirectGov), a U.S. Corporation that is a trusted partner of the U.S. Government and has been for more than 18 years. All its employees are U.S. citizens, with a third being U.S. Military veterans and more than 60% holding U.S security clearances.*

*Fuchs leads iDirectGov's team of federal systems engineers and serves as chief architect for new product integration and specialized technology including transmission security (TRANSEC), Communication Signal Interference Removal (CSIR™) anti-jam technology and Open Antenna Modem Interface Protocol (OpenAMIP).*

*All Defense-grade products sold by iDirectGov are designed, developed, assembled, programmed and verified within the United States.*

*Fuchs has more than 20 years of experience in the areas of technology and the federal government. He is a Senior Contributor to MilsatMagazine. [kfuchs@idirectgov.com](mailto:kfuchs@idirectgov.com).*



**CSIR™ Interference Mitigation Technology**



## THE SPACE REPORT 2021 Q1, EXECUTIVE SUMMARY

THE AUTHORITATIVE GUIDE TO GLOBAL SPACE ACTIVITY

By early April 2021, a sense of normalcy was beginning to return to daily life around the world. Spacefaring nations across the globe appeared to weather the worst of COVID-19 and were making pivotal decisions to grow their space capabilities.

The United States landed **Perseverance** on Mars, successfully hot-fired the SLS — the largest rocket body NASA ever developed — and was considering a presidential budget that increased the agency’s budget 6.3 percent from the previous year.

Further recognition of the developing cislunar economy came as the **Defense Advanced Research Projects Agency (DARPA)** awarded **General Atomics** a \$22 million contract to design a nuclear reactor for space propulsion.

China was moving forward to build its next space station, the **Tangong-3**, and announced the development of two new spaceports, and with Russia, had a new agreement to build a lunar space station.

India’s **Polar Satellite Launch Vehicle** assisted Brazil with monitoring deforestation in the Amazon rainforest by placing Brazil’s Earth Observation (EO) satellite, the Amazonia-1, into orbit. And with an eye to the future, four Indian cosmonauts completed training in Russia for India’s first manned space mission.

The **Space Report 2021 Q1** examines crucial markers of the 2020 space ecosystem — U.S. workforce data, investment and stock market activity, and launch analysis — and offers insights into the maturation of the **U.S. Space Force**, the growth of India’s civil space program and provides a “green” look at Space Products & Innovation.

Here are highlights of the Q1 edition.

### SPACE WORKFORCE

Analysis by The Space Report of **U.S. Bureau of Labor Statistics** for five key space sectors, those most closely aligned with the space industry, shows that hiring increased in all five, employing nearly 5,000 more workers in 2020, a 3.2 percent increase from 2019. Those new jobs helped propel private space employment to a nine-year high. In 2020, private space employment totaled 147,953 workers, the highest level since 2011, when 149,818 were employed. For one sector — **Guided Missile and Space Vehicle Manufacturing** — monthly BLS data shows another 1,000 employees hired from December 2020 to January 2021. That sector now has the highest employments levels since 1995, according to BLS data.

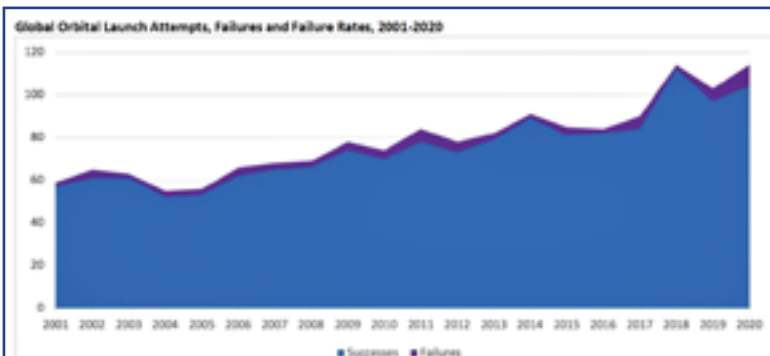


\* Preliminary estimate for the first half of 2020. Source: U.S. Bureau of Labor Statistics

## SPACE INFRASTRUCTURE

Of 114 launch attempts last year, 10 did not succeed — an 8.8 percent failure rate that is 1.8 times higher than the 40-year average and nearly five times higher than the 2018 failure rate, which also had 114 launches. Two factors that correlate with launch failures are higher numbers of orbital launch attempts and new vehicles. Both reached 20-year peaks last year

Research by The Space Report also found that, despite the often-cited statistic that 50 percent of maiden flights fail, data going back to 1957 places the average global maiden flight success rate at 83 percent.

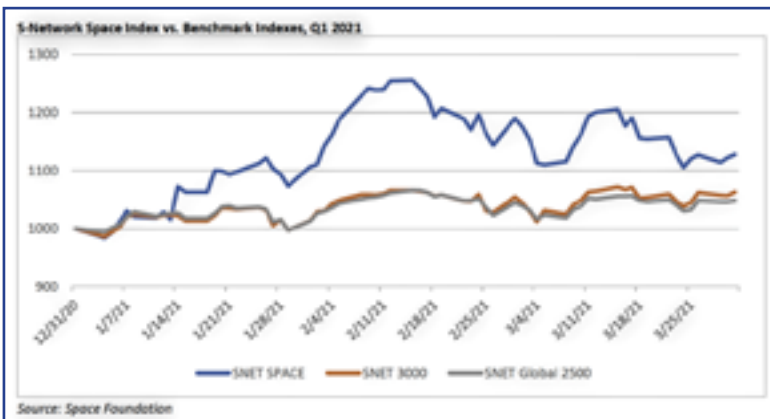


Notes: 2001: 2 failed launches, 3.4 percent failure rate; 2020: 10 failed launches, 8.8 percent failure rate. Source: Space Foundation database

## THE SPACE ECONOMY

As U.S. hiring has grown, so has investment. In 2020, space-related mergers, buyouts, and equity financings totaled \$18.2 billion. In the first quarter of 2021, activity across those same areas generated \$15 billion.

In stock market analysis, interest in Cathie Woods' **ARK Investment Management** space-related ETF fueled overall interest in space holdings, which helped propel the S-Network Space Index to a one-year gain of 97.5 percent as of March 23, 2021, nearly 11 percent higher than comparative indexes.



Note: Performance shown for each index is for the gross total return, assuming all dividends are reinvested.

On the high end of first-quarter market activity, Loral Space & Communications (+79 percent) continued to benefit from positive news surrounding its merger with satellite operator Telesat, announced in November 2020. The resulting company will be traded initially on the Nasdaq Stock Market (where Loral is currently listed). Investor interest was likely driven partly by operational announcements such as Telesat's \$3 billion award to Thales Alenia Space in

February to build 298 LEO satellites for its new Lightspeed broadband constellation.

## SPACE PRODUCTS & INNOVATION

Space agencies for decades have recognized multiple advantages associated with growing plants to benefit astronauts on long-duration missions, and by 2015, the first vegetables grown and eaten in space were cultivated on the International Space Station's Vegetable Production System (Veggie). Space technology research and development has led to the creation of innovative products that enrich and improve life on Earth.

Near the Arctic Circle, a collaborative research project, based on what was learned in space, is providing green, leafy vegetables to community elders, schools and workplaces. For others, space technology is as near as the kitchen counter. **AeroGarden** uses technology developed on the International Space Station to produce greens at a much faster growth cycle. Fueled partly by the pandemic, these systems have become so popular that for the last nine months of 2020, the company reported net revenue of \$69.1M, a 151 percent increase over the same period last year.

## About Space Report

The Space Report is widely recognized as the definitive body of information about the global space industry. It contains worldwide space facts and figures and is illustrated with photographs, charts, and graphs detailing the benefits of space exploration and utilization, the challenges facing the space sector, opportunities for future growth, and the major factors shaping the industry. The Space Report serves as a resource for government and business leaders, educators, financial analysts, students, and space-related businesses. For more than a decade, The Space Report has chronicled the growth of the space community from around the world.

Space Foundation's Research & Analysis team produces The Space Report and, in 2019, transitioned its annual summary into quarterly updates of global space activity. This new format makes it possible to provide the most up-to-date information on space infrastructure, facilities, launches, and programs.

Similar to other major economy-measuring indicators that inform our awareness of what is happening around the world, the quarterly installments of The Space Report are designed to improve our discussions and understanding of the reach, impact, and health of the space community.

For continuously updated information or historical data on the topics covered by the report, please subscribe to **The Space Report Online**. The online service also provides subscribers with searchable access to all the research conducted for The Space Report dating back to 2005. The full PDF is available for free to subscribers of The Space Report Online.

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For questions related to The Space Report content or the space industry in general, or to request customized research by the organization's Research & Analysis team, please contact [Research@SpaceFoundation.org](mailto:Research@SpaceFoundation.org).



## FOUR TIPS...

### FOR NAVIGATING EIS NETWORK TRANSITION

Author: Tony Bardo, Assistant Vice President of Government Solutions, Hughes Network Systems

**Since the start of the pandemic, there has been an unprecedented volume of network traffic from Zoom, Microsoft Teams, Slack, Workday, Blackbaud, Granicus, SAP and others. Traditional telecom services simply can't keep up with the increased traffic demands.**

Fortunately, *Software-defined Wide Area Network (SD-WAN)* technologies solve common issues, such as bandwidth congestion “at the edge” and enable government agencies to provide a consistent, positive user experience across all locations.

Creating a hybrid architecture — by adding managed broadband services to existing MPLS networks — effectively transforms and modernizes these end points in relatively short order.

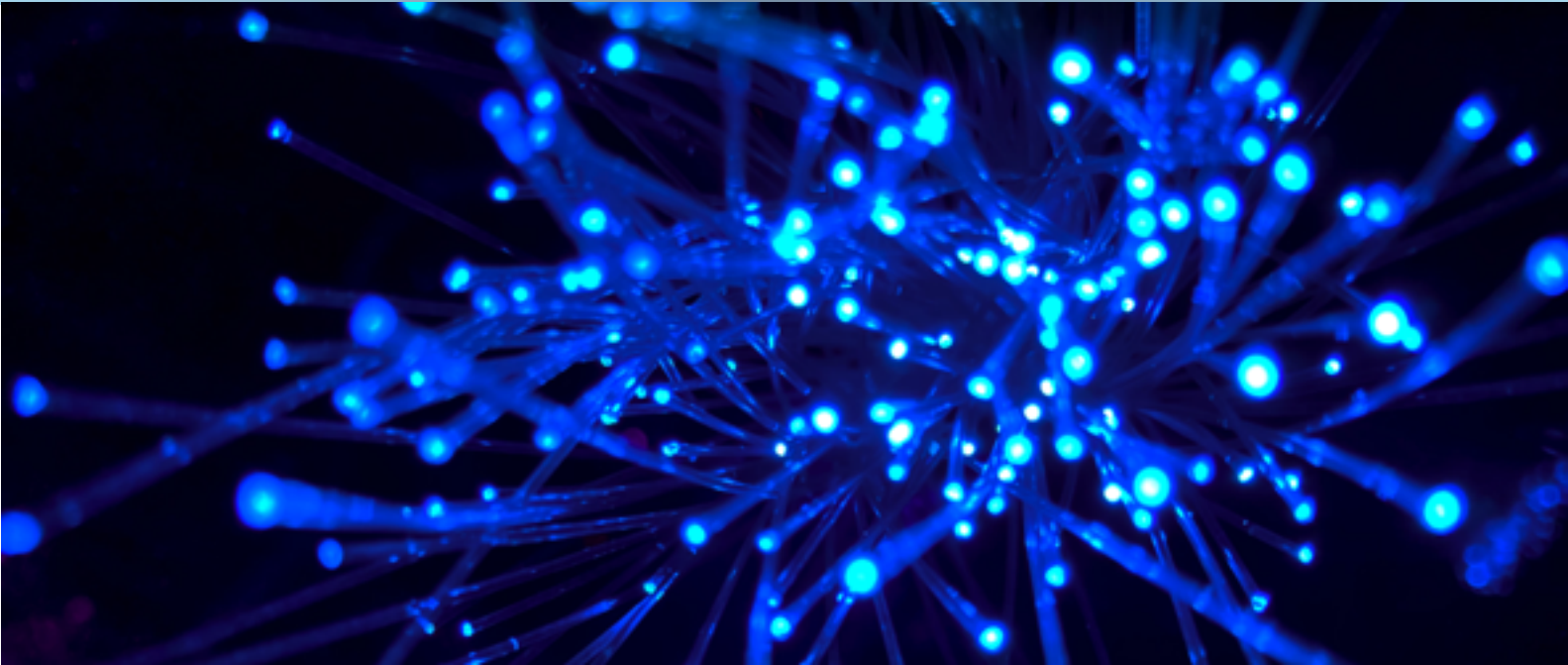
Recent modifications to the **Enterprise Infrastructure Solution (EIS)** procurement vehicle now enables federal agencies to modernize their IT infrastructure with SD-WAN technologies. Here are four tips for navigating the EIS network transition.

#### ISSUE A STATEMENT OF OBJECTIVES

Historically, agency IT teams have designed a dedicated network and outlined the specifications in a *Statement of Work* seeking the lowest cost technically acceptable. Today, agencies are better served by creating a *Statement of Objectives (SOO)* to summarize their high-level requirements for an acquisition.

Some examples of an SOO include:

- *Provide robust IT infrastructure services for all operations, logistics and maintenance functions.*
- *Provide system and network administration for all systems and applications located on the LANs.*
- *Implement a single help desk/service center capability to coordinate all maintenance issues with all customers.*



Rather than dictating technical specifics, the SOO encourages bidders to offer innovative and creative solutions that meet the agency's needs.

#### IDENTIFY CURRENT AND FUTURE APPLICATION DEMANDS AT FIELD OFFICES

Along with their SOO, agencies should document all current and desired applications in use across their enterprise. Case studies or examples can illustrate operational processes or public-facing interactions that the network must be able to support. These insights will help vendors understand bandwidth requirements on a site-by-site basis — a critical step to creating a modern and cost-effective network.

#### EVALUATE SD-WAN AS A MANAGED SERVICE

One of SD-WAN's greatest strengths is its ability to leverage various broadband transports — such as cable, fiber, 4G and satellite — to connect field office locations securely, reliably, and cost-effectively.

With SD-WAN, agencies can maximize existing bandwidth speed and performance without having to add new lines or links. Intelligent SD-WAN routers can automate path selection and other optimization features to yield instant cost and performance benefits, where they're needed most.

However, not all SD-WAN solutions are created equal: it's important for agencies to require prime contractors to propose multiple SD-WAN options and not simply their own, proprietary offering.

SD-WAN can also be implemented as part of a managed service to ease the burden associated with managing a complex distributed network.

For example, agencies with multiple field offices must manage hundreds of different *internet service providers (ISPs)* with different *Service Level Agreements (SLAs)*, contracts and billing structures.

An experienced Managed SD-WAN provider can simplify this process. Hughes accomplishes this task by tapping into the company's well-established global network of more than 400 ISPs. This ensures consistent performance across a customer's entire network, which is how tens of thousands of deployed SD-WAN sites are managed by Hughes.

#### SECURE ALL THE NETWORK'S ENDPOINTS

SD-WAN can also offset security concerns, especially when implemented as a managed service.

Under this scenario, SD-WAN provides next-generation firewalls with around-the-clock monitoring for each of the hundreds or thousands of endpoints on a network.

Additionally, SD-WAN is ideally suited to support the emerging cybersecurity architecture known as **SASE**, or **Secure Access Service Edge**, which applies policy-based security measures at the network's edge — no matter where users, applications or devices are located.

Because SD-WAN can be easily implemented on existing infrastructure, agencies can start now by modernizing at the edge with a hybrid approach — adding broadband connectivity to existing MPLS lines for diverse, dual-path networking.

With SD-WAN technologies added to EIS, agencies no longer need to be limited by the connectivity options available at their field offices, or by local service providers. They can meet application demands and user expectations and look for opportunities to evolve their operations to better serve constituents.

Starting from the edge inward gives an agency time to phase the modernization process across the network — all without impacting the core, which in most cases already has adequate bandwidth. However, with the EIS deadline now set for 2023, agencies are urged not to wait any longer before they initiate this crucial transition.

[www.hughes.com](http://www.hughes.com)

# THE NEED FOR GLOBAL FIPS 140-2 COMPLIANT SAT SERVICES

KYMETA'S TRANSEC SECURE NETWORK

Author: Isabel LeBoutiller, Vice President, Connect & Government Programs, Kymeta

Particularly in popular culture and casual references, satellite networks are commonly referred to as "secure," as if sheltered from the prying cryptological eyes of adversaries and hackers and the would-be attacks other enterprise networks face. Unfortunately for operators and users of VSAT alike, white-hat hack attempts and genuine malicious threats in recent years have shown that satellite networks are not immune to such threats.

Security consulting group [IOActive](#) demonstrated back in 2014 that satellites and satellite networks could be compromised in a number of ways — the application of malicious firmware to obtain GPS coordinates or disable communications, exploiting modem admin code backdoors to install malicious firmware, and compromising terminals through authentication mechanisms, among others.

Coverage map of Kymeta's Global TRANSEC Secure Network.

The U.S. and Canadian government response to crypto security challenges for all digital network technologies is [FIPS 140-2](#), a federally managed standard of security policies and requirements with which technologies must comply to be cleared for use. How does this apply to satellite networks?

Governments around the world have struggled to counter such threats given the cost and quick-changing nature of VSAT technologies as well as the use of service provider-controlled commercial satellite networks.

To meet the FIPS 140-2 requirement at Level 3, [ST Engineering iDirect](#), the largest commercial VSAT platform operator for US Government customers, offers its TRANSEC Module, an embedded card providing cryptography that is installed on the motherboard of a hub line card or a remote modem with unique firmware.

Among other functions, the card encrypts and protects data packets transverse the network between the line card and the remote, ensuring data integrity while data is in motion.

To date, ST Engineering iDirect is the only FIPS 140-2 compliant commercial satellite network platform solution on the market.

While *Department of Defense (DoD)* groups who operate their own networks have adopted the TRANSEC platform, Government users of commercial SATCOM offerings are struggling to obtain waivers for non-TRANSEC services. Increasingly, DoD customers who do not operate their own networks are seeking a commercially available, FIPS 140-2 compliant offering.



# FEATURE

In response to this demand, **Kymeta** has recently launched its **Global TRANSEC Secure Network (GTSN)**, the first commercially available network of its kind, ensuring that customers and partners can receive the highest levels of encryption, authentication, and traffic concealment while exceeding the current requirements outlined by the U.S. Government.

The satellite service offering provides full compliance with numerous Federal and DoD standards, including the *January 2021 DOD Instruction 8523.01*.

The newly launched Kymeta Global TRANSEC Secure Network covers the U.S., Middle East, and Europe, and secures VSAT transmissions from interception and exploitation by incorporating encryption inherent in COMSEC, conforming to 256-bit AES as specified by the Federal Information Processing Center (FIPS) 140-2.

Additionally, because the network is engineered to support Kymeta's, flat-panel *Communications-On-The-Move (COTM)* and *Communications-On-The-Pause (COTP)* antenna, it is capable of supporting all sizes of existing VSAT terminals used by government customers on a global basis.

Indeed, Kymeta has integrated **iDirect's 950mp** modem, which supports TRANSEC operations, into the new Kymeta **u8 GOV terminal** (pictured below, in transport case) to offer government, military, and other users who require the mandated enhanced security features the same revolutionary software-defined, electronic beam steered antenna system as the company's u8 commercial offering.



The u8 GOV variant's 950mp modem *iDirect Certificate Authority (CA)* issues an *x.509 digital certificate* to ensure proper authentication between the remote terminal and the hub.

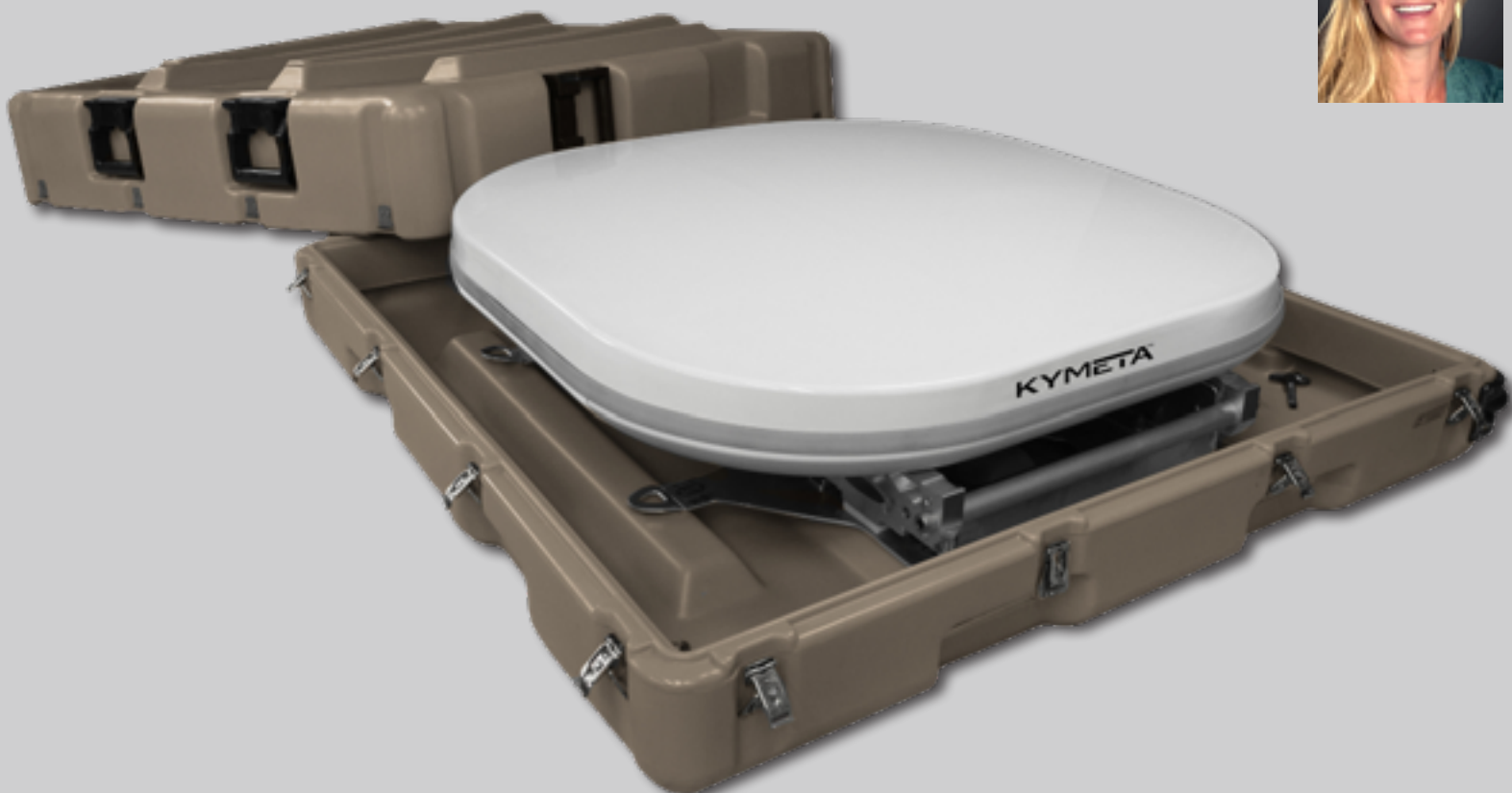
Kymeta plans to continue the expansion of its existing TRANSEC network coverage as demand grows. Through the company's subsidiary, **Lepton Global Solutions**, the network can support both the u8 GOV variant as well as other terminal technology that uses iDirect's family of *TRANSEC-compatible* modems.

The GTSN network offering includes a "*Bring-Your-Own-Device*" capability to current Government users of satellite who require a FIPS 140-2 compliant VSAT network.

**Rob Weitendorf**, who oversees Business Development for Kymeta's Government customers, shared his thoughts on why the launch of the first commercially available TRANSEC network was so critical to Government customers and said, "*Over the past 18 months, we have seen significant demand for secure, uninterrupted satellite communications from our U.S. Government and other customers. With the launch of this new service, we will be able to deliver on what has been needed and mandated. TRANSEC requires all system control channels to be encrypted so that any traffic engineering information is obfuscated from an adversary, making our TRANSEC-enabled network highly secure and capable of mitigating threats and maintaining operational security.*"

[www.kymetacorp.com](http://www.kymetacorp.com)

Author Isabel LeBoutiller is the Vice President, Connect & Government Programs, Kymeta



# 2020s THE SPACE DECADE

## THE TOP FIVE NATIONAL SECURITY SPACE ISSUES

OF 2021

Author: Aliza Goldberg, External Communications Lead, Peraton

*"It is our responsibility as leaders of the defense enterprise to make sure that we continue to educate the population about the threats that we face and then put forth recommendations to deal with those threats in a rapid, responsive way," said Air Force General John E. Hyten, Vice Chairman of the Joint Chiefs of Staff at a January 2021 National Security Space Association event.*

Much progress has been made in space exploration, space-based technological innovations and space defense. The United States had several successful rocket launches in 2020, including the first Americans in nearly a decade to reach orbit from American soil — and the **Perseverance** rover landed on Mars.

**SpaceX** created a reusable rocket booster, which will lead to less expensive, faster and more sustainable space assets. Advancements in the ability to launch dozens of satellites on a single launch will enable humans to explore new concepts for proliferated **LEO** satellites to enhance resiliency and add new missions that previously were not practical.

With each advancement, however, comes a new target.

During the next few years, the space economy will grow to more than \$1 trillion—*"...it underpins every instrument of national power,"* said U.S. Space Force General **John W. Raymond**, Chief of Space Operations at the **Air Force Association's Aerospace Warfare Symposium**. The future of space defense depends on managing risk while continuing to seize opportunities and excel.

As the world settles into the 2020s, here are five national security issues in international space policy, defense posturing, space domain awareness, and systems integration for space capabilities that need to be addressed.

### 1. Agree on space guiding principles.



To reduce the risk of miscalculation in space, it is important to obtain international agreement on what behavior is or is not considered provocative, reckless, or hostile.

Defining norms of behavior will make it easier to understand if someone is acting unsafe or recklessly, or if they are purposefully threatening the United States, American allies, or a commercial spacecraft. Until there is more clarity, every action in space carries a degree of ambiguity and the risk of misinterpretation of actions in space remains high.

*"No one wants war in space, so we must make every effort prevent it. Having commonly accepted, unambiguous rules will definitely play a big part to minimize avoidable confrontation,"* explained **Dean Bellamy**, Peraton's Vice President, Space Strategy.

Obtaining interagency agreements on what actions will deter or fuel adversaries will be of utmost importance in 2021 and beyond.

## 2. Take space warfighting seriously.



Given the significance of space activities, unfettered access and freedom to operate in space is vital. Military and civil organizations depend on space-derived data for communications, weather, navigation, and intelligence. Preventing potential aggression in space requires deterrence, and the next step for successful deterrence requires the development of a holistic interagency strategy.

Russia and China's actions continue to push space into a warfighting domain with their continuous testing of space-based and ground-based weapons intended to target and destroy U.S. and allied satellites.

In December of 2020, Russia conducted its second test of an *anti-satellite (ASAT)* missile, designed to destroy satellites in *Low Earth Orbit (LEO)*. Russia has also demonstrated hostile satellite maneuvers and developed both anti-satellite laser systems and satellite jammer systems.

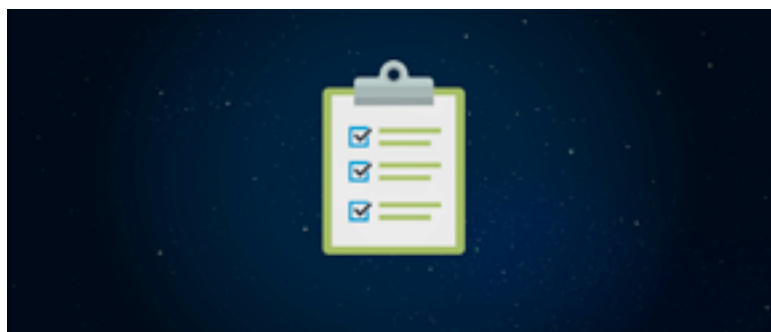
China also has several ASAT missiles for targeting LEO satellites and is working on an ASAT weapon for satellites in *Geosynchronous (GEO)* orbit, along with a ground-based anti-satellite laser system. In the *Department of Defense (DoD)*'s annual report to Congress on Chinese military activity, the Pentagon also lists electronic weapons such as "*jammers*."

General *John Hyten* described the situation that currently exists in space when he stated, "If you are being challenged in the space domain just like you're challenged in air, land, and sea, then you better figure out how to defend yourself. Build a more resilient architecture so you're not threatened and so you can fight through any threat effectively."

Adversaries' provocative actions demonstrate the importance of space warfighting capabilities. The U.S. military needs to be able to respond to threatening activities accurately and quickly.

"Despite setbacks due to COVID-19, 2020 also brought a host of new beginnings," said *Bellamy*. "The standup of the U.S. Space Force and U.S. Space Command last year could not have been any more timely. Even though we have not yet fought an actual war in space, the military, civilians, and Peraton contractor personnel who work in the National Space Defense Center are doing a phenomenal job protecting and defending our space assets from both terrestrial and on-orbit threats."

## 3. Map out a full picture of what is in space.



Peraton's orbital analysts calculate the location and trajectory of customer satellites daily for both situational awareness and defense purposes in order to ensure mission success.

Knowing where all space-based objects are located and who owns them is crucial for space defense decision-making. Tracking and cataloging space objects avoids accidental collisions and defends against adversarial activities in space. Even a small sliver of space debris can cause consequential damage due to its high velocity. The more satellites launched into orbit, the more coordination is needed to ensure safety.

Traditional *Space Situational Awareness (SSA)* and *Space Traffic Management (STM)* missions have been focused on daily tracking and reporting of space objects to avoid collision. In a contested space environment, these space objects will not move along the predicted trajectory. Adversaries will maneuver threatening space assets or launch ground-to-space ASAT missiles on short timelines to create tactical surprise.

*Space Domain Awareness (SDA)* is now needed for this new paradigm of maintaining tight knowledge of the location and trajectory of every object in space with short observation revisit times and tactical update cycles.

Along with SDA, it is also important for the U.S. military to share information across branches. Former Secretary of the Air Force *Barbara Barrett* and General *Hyten* have both pointed out that it is time to reexamine how space warfighting capabilities are classified, so that more information can be declassified and accessed.

"The U.S. Space Force should reveal more capabilities to deter adversaries," said *Trey Spetch*, Peraton's Senior Director of Strategic Space Capabilities. "This may require a strategy to reveal the fact of our defensive space capabilities for effective deterrence, without compromising sources, methods, or detailed performance and limitations."

## 4. Use a battle management system for a coordinated space response.



Integrating space-derived capabilities into multi-domain warfighting is a top priority for delivering GPS data, satellite communications, and other space effects to soldiers, sailors, marines, and airmen. In the next conflict, the United States must be able to rapidly collect, analyze, and share information in order to make actionable decisions across space, air, land, sea, and cyber domains.

Information saturation is a concern, so it is essential for the space operators to have ground mission systems that receive, fuse, and make sense of the vast array of data and information quickly. Contested environments need a distributed-but-integrated system comprised of multi-domain sensors, cloud computing, and AI to compose a single picture of the battlefield.

*Advanced Battle Management System (ABMS)* and *Joint All Domain command and control (JADC2)* systems will enable the U.S. Air Force and U.S. Space Force to operate together as part of a joint team; these technologies will enable decision makers to have actionable information at the speed of relevance. As ABMS and JADC2 mature, these systems will enable unity of action across domains.

## 5. Develop digital engineering and model-based systems engineering (MBSE) on ground mission systems.



Traditional MBSE helps programs maintain and track functional requirements, interfaces, and design baseline characteristics throughout a program lifecycle. However, MBSE tools cannot perform the necessary analysis to assess system performance in a relevant environment. In order to analyze and calculate system performance metrics, physics-based models and simulations are needed to handle aspects like the non-linear

access windows between satellites, targets, and ground terminals, as well as atmospheric attenuation of radio frequency (RF) links and communication availability levels under various rainfall situations.

“MBSE plus physics-based modeling equals digital engineering,” *Spetch* explained. “We are marrying these capabilities to create a true digital engineering environment at Peraton, one in which our space and ground architectures report back to the system engineers on the satisfaction of performance metrics.”

The implementation of digital engineering will accelerate design and development cycles, enabling full system performance verification before moving forward to bend metal. It also eliminates the need to expend time and resources building prototypes for performance testing.

Digital engineering provides a functional and performance model for a system, along with a simulation of the relevant environment, that persists throughout the lifecycle of a program. Implementing digital engineering across the entire space enterprise allows the U.S. to keep up with the pace of foreign threats to its architecture.

“Peraton has a long history of developing software systems needed for ground and space-based data processing,” said *Spetch*. “We provide integrated and interoperable battle management, command, control, and communications, mission planning, space and ground processing frameworks, and multiple security-levels of data dissemination for sensor data fusion. With Peraton’s history and war wounds, we can create the mesh networks, distributed processing, and decision-making systems needed for efficient and intelligent satellite communications.”

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## SPACEBRIDGE'S VSAT ROUTER INTEGRATED INTO C-COM'S INETVU ANTENNA CONTROLLERS

**C-COM Satellite Systems Inc. (TSXV: CMI and OTCQB: CYSNF) have completed integration of the SpaceBridge U7400 Professional Modem Series for Mobility/Trunking VSAT Router with its iNetVu® antenna controllers. The latest SpaceBridge VSAT networking platform, which encompasses several new modems, is now fully compatible with all C-COM Flyaway and Driveaway antenna systems.**

Using the [SpaceBridge U7400 VSAT router](#) and testing for satellite acquisition, C-COM's 98 cm Ka-band driveaway antenna system configured with the iNetVu® 7710 controller, was able to seamlessly acquire satellite in under two minutes and offers interoperability with 15 different modem manufacturers and with more than 37 different models.

The interoperability of the SpaceBridge U7400 Professional Modem Series, with its OpenAMIP supported capabilities and its integration with C-COM's antenna systems, enables users to leverage high performing, efficient and reliable connectivity solutions for demanding mobility applications.



C-COM iNetVu® Ka-98G with 7710 Controller & SpaceBridge U7400 Router

C-COM mobile antennas with iNetVu® controllers, compatible with U7400 series VSAT L3 Switches, are now available for immediate delivery.

*"We are happy to add the SpaceBridge U7400 highly advanced networking platform to our list of*

*integrated and supported VSAT modems,"* said **Leslie Klein**, President & CEO of C-COM Satellite Systems, Inc.

*"C-COM is a valued partner that we enjoy collaborating with. The SpaceBridge U7400 Professional Modem Series with our unique WaveSwitch™ multiple waveform switching capabilities, provides the versatility needed to succeed in mobile communication transition between MFTDMA and SCPC over a single Modem,"* added **David Gelerman**, President and CEO of SpaceBridge.

## USAF'S AIR COMBAT COMMAND ADDS TO APOGEE'S ISR, CYBERSPACE + INNOVATION DIVISION CONTRACT



Recently, **Apogee Engineering** (Apogee) marked their first year anniversary by adding to their contract with **Air Combat Command's** Intelligence Directorate (ACC/A2) to provide requirements analysis, systems engineering and operational subject matter expertise in the *Air Force Cryptologic Office's (AFCO) Intelligence, Surveillance, and Reconnaissance (ISR)–Cyberspace and Multi-Domain Innovation Division*.

In this role, Apogee provides highly qualified staff support to help Sixteenth Air Force (16 AF) fulfill its mission to integrate multi-source ISR, cyberspace operations, electronic warfare (EW), and information operations (IO) capabilities across the conflict continuum to ensure the USAF is fast and fully integrated in both competition and war.

In supporting the Cyber Multi-Domain Innovation Division, the Apogee Team conducts studies, analyses, and evaluations to advance multi-domain requirements definition, capability development, force modernization, and experimentation activities.

Apogee also provides assessments and evaluations related to the development of urgent operational capabilities that deliver multi-domain, cross-functional effects to air component commanders and integrate cyberspace operations, ISR, and EW technologies through rapid development of innovative multi-domain operational capabilities and non-kinetic operations planning support.



In its **Defensive Cyberspace Operations (DCO)** support role, the Apogee Team applies its knowledge and experience with USAF DCO and ISR operations to advise and assist 16 AF staff on ACC, USAF, National Security Agency, and USCYBERCOM cyber-related intelligence and ISR issues.

Apogee supports the 16 AF information warfare mission by analyzing and providing technical advice on “*ISR for DCO*” capabilities and tactics in competition and war.

Primary work for Apogee’s ACC and 16 AF support will continue to be conducted at **Joint Base Langley-Eustis** in Hampton, Virginia, and **Joint Base San Antonio** in San Antonio, Texas.

“As illustrated in President Biden’s Interim National Security Strategic Guidance, the global security landscape is being shaped by the convergence of actors, technologies, threats, and vulnerabilities in the dimensions of ISR, space, cyber, IO, and EW – all overlaid on a digital matrix of next gen communications, big data, and artificial intelligenc,.” said **Frank Varga**, Apogee Vice President of Operations. “We look forward to continuing to work side-by-side with Air Combat Command and 16th Air Force develop integrated, multi-domain capabilities to meet the challenges described in the President’s guidance.”



## IRIDIUM®'S PUSH-TO-TALK SOLVES INDONESIAN GOVERNMENT'S REMOTE COMMUNICATIONS CHALLENGES



The Indonesian government now has a reliable “grab-and-go” real-time satellite communications solution, ideal for communications on-the-move applications across the country’s diverse island landscapes. By fully deploying 500 *Iridium* PTT handsets the Republic of Indonesia’s government has adopted Iridium Push-to-Talk (PTT) devices to support communication efforts across the country.

As the largest archipelago in the world, Indonesia is made up of five major islands and more than 17,500 smaller islands, of which about 6,000 are inhabited.

The size and scope of its territory makes building and maintaining cellular or land-mobile radio (LMR) network infrastructure expensive, challenging and impractical. It also leaves a need for communications resiliency across all of Indonesia, especially during and after natural disasters, as the country’s topography is subject to earthquakes, volcanic eruptions, and tsunamis

During emergencies, Indonesian government personnel deploy on Search and Rescue missions to its remote islands that may have damaged or unreliable connectivity. Iridium PTT is helping the country conquer these challenges, immediately providing an easily deployed, cost-effective solution for reliable real-time communications on land, at sea or in the air.

Iridium service provider **PT Amalgam Indocorpora** supported the implementation by providing the Indonesian government with customized **Icom IC-SAT100 PTT** devices. With one-to-many communication at the push of a button and Iridium’s truly global coverage, the devices help ensure Indonesian government personnel remain connected.

This capability brings immense value to the Indonesian government as they bridge the previous connectivity gap, allowing deployed teams to efficiently communicate with one another across the country’s islands over the Iridium network.

The IC-SAT100 is a compact, user-friendly radio with military grade ruggedness and includes a high audio speaker to ensure communications clarity, even in high ambient noise environments.



Radio-style control knobs and a familiar LMR user interface make the IC-SAT100 incredibly easy to operate for existing radio users.

With real-time, one-to-many communication, the highly secure service has end-to-end AES-256 encryption, making it an ideal option for militaries and government organizations in need of global group communications capabilities offering operational security and safety. Users will know that regardless of where in the world they need to deploy personnel and assets, they will remain within coverage.

*“The small, lightweight and high-performing IC-SAT100 PTT device is the ideal tool for keeping dispatched personnel connected beyond the reach of traditional LMR networks,”* said **Bryan Hartin**, executive vice president of sales and marketing, Iridium. *“In Indonesia’s remote locations, where terrestrial networks are limited or non-existent, and in disaster-affected areas where terrestrial networks are damaged, the government can rely on the Iridium network to stay connected.”*

*“From customization to activation, it was an honor to work with the Indonesian government to ensure device best practices and a swift deployment to the field,”* said **Andre Halim**, president director, PT Amalgam Indocorpora. *“With a full suite of Iridium solutions, we are committed to working closely with our customers to support their vast connectivity needs.”*

PT Amalgam Indocorpora also supports customers’ connectivity needs for businesses and governments with Iridium Certus® and IoT solutions, for tracking personnel and assets, command and control, situational awareness and more.

Iridium Certus is the only global broadband service that provides weather-resilient coverage for on-the-move internet and high-quality voice access.

# U.S. SPACE COMMAND — INNOVATION & DEFENDING SPACE ASSETS

A KRATOS CONSTELLATIONS PODCAST TRANSCRIPTION WITH...

BRIGADIER GENERAL BROOK LEONARD, CHIEF OF STAFF, U.S. SPACE COMMAND

Interviewer: John Gilroy

Brig. Gen. Brook J. Leonard is the Chief of Staff, United States Space Command, Peterson Air Force Base, Colorado. He is the principal advisor to the USSPACECOM commander and deputy commander, and directs the activities of the command staff in order to deter aggression and develop combat ready forces prepared to fight for and preserve United States and allied space superiority. He chairs numerous boards, oversees the command's corporate process and serves as the director of the commander's staff.



Prior to assuming his current position, Brig. Gen. Leonard was the Director of Air Operations, Combined Joint Task Force, Operation Inherent Resolve; the Commander, 321st Air Expeditionary Wing; and the Commander, Task Force - Air, Union III, Baghdad where he was responsible for leading a task-organized unit across 11 locations in Iraq and Syria to defeat the Islamic State group and enable security across Iraq through training, advising and assisting, airfield operations, cargo processing and personnel movement in support of Coalition and Partner forces. Additionally, Brig. Gen. Leonard served as the Deputy Commander of the 9th Air Expeditionary Task Force, Levant.

Brig. Gen. Leonard entered the Air Force in May 1992 as a graduate of the U.S. Air Force Academy. He earned his pilot wings from Euro-NATO Joint Jet Pilot Training at Sheppard Air Force Base, Texas, and was a distinguished graduate of the F-16 Fighting Falcon Initial Qualification Course at Luke AFB, Arizona, in 1995. He has held a variety of flying assignments and has commanded the 16th Weapons Squadron, U.S. Air Force Weapons School, Nellis AFB, Nevada; 451st Expeditionary Operations Group, Kandahar Airfield, Afghanistan; 51st Fighter Wing, Osan Air Base, South Korea; the 56th Fighter Wing, Luke AFB, Arizona; and 321st Air Expeditionary Wing, Baghdad. Brig. Gen. Leonard served on the Joint Staff as Division Chief, Iran and Levant Division, Deputy Directorate Political-Military Affairs Middle East and was the Senior Military Assistant to the Secretary of the Air Force. He is a command pilot with more than 3,000 flight hours including 576 combat hours.

**The Constellations' guest is Brigadier General Brook Leonard, Chief of Staff, [U.S. Space Command](#), the principal advisor to the USSPACECOM Commander and Deputy Commander. General Leonard discusses the increasing role of U.S. Space Command, the importance of innovation in a warfighting environment and where the digital space race fits in to overall command policies.**

**John Gilroy (JG)**

*Thank you for joining us, General. The U.S. Space Command reestablished a little over a year ago and seems to be acquiring new areas of responsibility all the time. What does US Space Command cover today?*

**Brigadier General Brook Leonard (BL)**

Thank you for the opportunity. Yes, the U.S. Space Command is expanding. It's a growth business. We like to call ourselves Space Command 2.0.

As we restood up Space Command 2.0 last year, we adopted not only all the roles and responsibilities of the first Space Command and supporting terrestrial operations, including

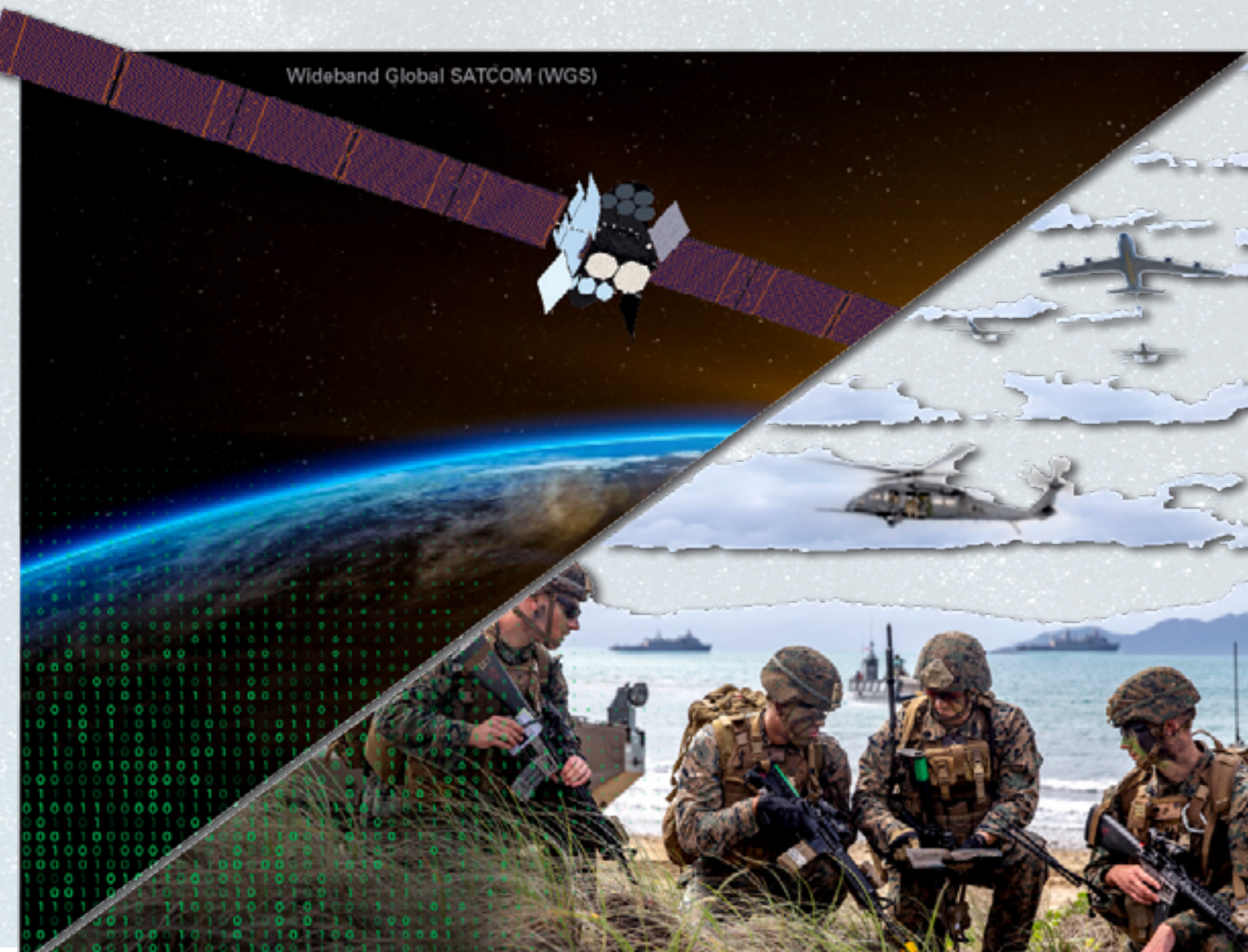
missile warning, precision navigation and timing, and satellite communications, but also protecting and defending our satellite assets on orbit.

Our area of responsibility is essentially 100 kilometers and up, 'To infinity and beyond' we like to say. There is no boundary, but it definitely ends on one side at 100 kilometers.

We're also trying to protect and defend not only our on-orbit assets, but also those of our allies, including our commercial partners. We need to ensure we stay ahead of our adversaries, out-thinking and outmaneuvering them. To do that, we need really smart, bright, and innovative people that understand both space and warfighting.

**JG**

*To win and "out think" sophisticated adversaries requires innovation. Dr. Will Roper, the Assistant Secretary of the Air Force for Acquisition Technology and Logistics, recently wrote, "We have remained a flip phone military in a smartphone world." How do you foster a culture of innovation at USSPACECOM?*



**BL**

I love Dr. Roper's analogy. We're focusing our innovation on our ability to understand, decide, and really out-act our opponents. First is how we think. Second is the technology that helps us, and then, how we're organized.

We're looking for innovation to help us make big leaps. If we just continue to evolve, China or Russia may evolve in some ways faster than us. So we need to make those revolutionary jumps and innovation

We're focused on holistic thinking with "no lines on the map." Rather than thinking of the world in terms of geographic regions, we need to think globally about the entire enterprise that feeds into space.

We also prioritize loop learning, our ability to stay agile, to continuously guess, experiment, test, scale, learn, and repeat. Then third, we're looking at making sure we have a shared understanding across our force. Then fourth is decision superiority, our ability to make decisions faster than our enemy, about understanding the enemy and how they think.

It's also about understanding how others think around us and considering their ideas. And so we've entered into collaborative environments to really get the best out of different organizations on how we do warfighting leadership in space.

To make certain we innovate and mature our technology to get to the state of the art, if not beyond. We're looking at technologies that allow us to pull in all levels of data so we can use machine learning and AI, as well as team that up with human experts and get that data back out for decisions in a customizable way across all ranks.

Organizationally, we're looking to what I call Cyborg, where technology is at the core and wrapping our organization around that. We want an ambidextrous organization that preserves the design, creativity, and forward-thinking, along with the ability like all military organizations, to do the nuts and bolts planning and execution.

We have to be good at both. We have a strategic initiatives group focused on that forward creative thinking while still keeping in place that machine of execution. Those are examples of how we're pursuing innovation across US Space Command.

**JG**

*Protecting our and our allied partners' interests in space seems to be pushing the US military to more closely integrate within its services. Can you tell us how the U.S. Space Command is supporting the sharing of data and integration of all service branches and international partners?*

**BL**

We're looking not only to integrate across all the different facets of US Space Command, but also to become interoperable, to mix different capabilities, to be interchangeable so that we have a resilient architecture. That's key.

First, we need to be interoperable with what we call the **Joint Force**. All the different services in charge of their domains bring their experts to U.S. Space Command, and leveraging the understanding of their service and their capabilities and their sensors and trying to stitch those together.



Dr. Will Roper

It's really important that we can outmaneuver the enemy and partnering with our joint forces to have space capabilities that give us that multi-dimensional, multi-layered interoperable capability across our commands.

On top of that, we want to go out to our allies and partners. We already have over 160 sharing agreements with different allies and partners. Again, stitching together and making sure it's interoperable. Last, but not least, we must stitch together relationships and partnerships with the commercial world.

**JG**

*What is the role of commercial industry in helping the U.S. Space Command in competing and fighting to maintain our space superiority?*

**BL**

The commercial world can really help us, and there are three categories. How do we learn from the commercial world and leverage what they have? How are they thinking about technology, and how are they organized? We need to adapt the state of art from the commercial world because it's far ahead of what the military is doing in some ways. How do we partner to learn about their capabilities and move to leverage those capabilities?

A small example is reusability. This cuts down on costs from a logistic standpoint and allows us to refresh and refurbish our assets on space at a lower price point, more rapidly, to be more robust and resilient. Stitching together small sensors that are numerous and more interconnected is another example.

Last but not least, to lead from a secure, protect, and defense standpoint. We want to make sure as the military, we start looking alongside our commercial partners to the economic benefits and the peaceful development of space and how we, as a military, can protect those lines of communication, those lines of trade.

**JG**

*We often hear the question about what type of company is going to win in the next five years? And the conclusion is those that are creative. That innovation is the new competitive advantage. We know that our near peer adversaries are doing things to be more competitive. How do we keep and ensure our competitive advantage in the future?*

**BL**

I absolutely agree that innovation is the new competitive advantage. That starts by investing in our people, how those people think, the technology they use, and how they're organized. That we have loop learning, and an environment where they feel creative and their ideas are valued.

Like I said, it starts with your people, not only the tools and the mindset, but an open environment to glean those great ideas and put them to use. We have to keep pushing the edge forward and experimenting. We have to have tolerance for risk, to have that empathy that allows a creative space for our people, to invest in an organization that preserves and protects that creative design space, and rewards people for creative ideas, and the folks that do that everyday sort of execution.

We need to build an organization where those are valued. Overall, understand that a lot of different people have great ideas. We need to keep that mindset of taking those huge leaps and that's how we ensure our future competitive advantage.

**JG**

*Former Defense Secretary Mark Esper said that competitors are seeking new ways to exploit our systems and undermine our military advantage. The space race has become a digital space race. Is artificial intelligence a technology that can help here?*

**BL**

The digital age is affecting everything, whether it's space, or in our everyday life, how we understand and decide and act. We have apps on our phones that tell us, "there's traffic here. Or maybe there's a detour here." That's an everyday, almost archaic example of how the digital age has invaded every single area of our lives and brought about this connectiveness, but space really brings out an incredible amount of connectedness across our joint force to include our allies and partners and our commercial assets out there.

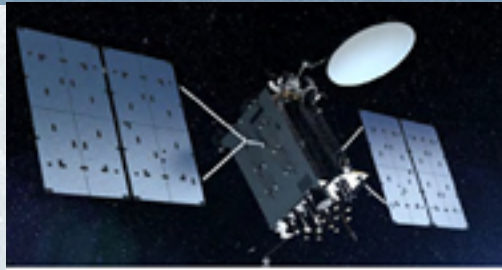
Our focus is to break our enemy's decision cycle and connectiveness and to build on our decision cycle and connectiveness. Whether that's artificial intelligence and machine learning and the need to couple it with a human warfighter or operator that understands the information. Where we would like to get to is that technology, that machine learning and AI, to be predictive and prescriptive. That will help us run a decision cycle that's faster than our enemies and maintain that competitive advantage.

**JG**

*Dr. Roper said that he wants to fast forward a digital engineering revolution. What are the steps needed to fast forward that type of capability at Space Command and the DOD in general?*

**BL**

I absolutely agree with Dr. Roper again. He has great thoughts on this and I would focus that comment on: we need to fast forward a digital engineering revolution in the military. In many ways that digital engineering revolution has swept our society and everything that we do. And I would tell you, our enemies have really gone to school at how we fight, how we fight in space, and how we fight across the joint force — they understand that



innovation and technology and space capabilities are central to that and so they're obviously going after that.

We very much need to accelerate in that area as well. We look across the digital engineering revolution as accelerating our people's capability, our partnerships, and our persistency, which means being persistent, consistent, and excellent.

To the digital engineering revolution with our people, we need to take the technology they use in their everyday life and adapt that capability to understand, decide, and act into the military. Again, people are so important to this and their ability to bring to bear their ideas. Then there's partnerships, absolutely making sure we leverage all the different ideas out there, all the different technologies, whether it's allies, whether it's commercial, whether it's the other services.

Then that persistency part, to make sure we stay focused, that we don't just add digital engineering and then revert back to our old ways of focusing just on hardware, but not on software, or focusing just on certain machines, but not the web that connects them.

We must be very consistent with our requirements — if you're going to build something for U.S. Space Command, it needs to connect to a larger web of sensors, deciders and actors. And then there's excellence. We need to demand that capability stay ahead of the enemy's capability.

We're looking to make sure that we stay on point with big leaps. We're not interested in small evolutionary technology, but instead, what's around the corner to pay huge dividends that change the game. That's how we think about the digital revolution. People,

partnerships and that persistency are going to help us get there.

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**SPACE DATA  
ASSOCIATION**

*'An association of global satellite operators working to ensure a controlled, reliable and efficient space environment'*

## ENSURING A COORDINATED APPROACH TO SSA

*Author: Pascal Wauthier, Chairman, the Space Data Association*

**Space Situational Awareness (SSA) has risen up the agenda recently. With an ever-increasing number of satellites in orbit and many new launches planned, it is more important than ever that we can remove existing debris, reduce risk of creating more debris, and track all objects to ensure good SSA and collision avoidance.**

It is reassuring to see that there has been a lot of innovation and initiatives in this arena. However, with so many different providers looking to provide solutions to this, many of which are also looking to the satellite industry to fund these endeavors, are we at risk of duplicating efforts? How do we ensure a coordinated approach and who should fund these measures?

### THE CURRENT STATE OF DEBRIS

The space environment surrounding Earth is full of debris as a result of hardware leftover from the many thousands of satellite launches by humankind, dating back to 1957 and of collisions between objects. It's difficult to precisely estimate the exact number of pieces of debris in space, partly due to our inability to track smaller debris, but there are approximately 21,000 objects currently tracked and an estimated half a million to one million fragments between one and ten centimeters in size that we cannot track. Orbital debris as small as 20 cm in size is capable of inflicting severe damage to active satellites.

On top of the debris problem, the space environment is becoming more and more crowded, as planned satellite

launches into all orbits continue to accelerate. This makes the problem of safety in space two-fold, as debris poses a significant threat to operating spacecraft in terms of collisions, and this spacecraft operates in an ever more congested space. Furthermore, continuing fragmentation of debris will increase, creating new hazards.

As the SDA has asserted for some time, the growing problem of debris is very likely to threaten our industry's ability to operate in space at all, which clearly has commercial but also societal consequences for the people on Earth who rely on key satellite services. What's particularly concerning in this respect is the effect that increased debris in LEO could have on our ability to launch into MEO and GEO — and of course we know that smallsats and other launches in this lower orbit are increasing perhaps by a factor of five or even ten, plus LEO is already the most debris-filled region.

### RECENT INNOVATIONS

In recent years the industry has been innovating many tools for debris removal and improving SSA. As such, we now have a growing toolbox of strategies and technology to help us get on top of the situation. Most of these new tools center around effective SSA and avoiding causing more debris, as well as finding new ways to remove existing debris.

Our own [Space Data Center](#) (the operational arm of the [Space Data Association](#)), is providing standardized, validated

Space Data Center

operator data which is helping to enable collision avoidance maneuvers and provide accurate conjunction warnings.

SDA members today account for more than 270 GEO satellites, more than 50 percent of active satellites and more than 400 from other orbits. The data provided by these members includes up-to-date ephemerides that are key for SSA and for allowing space users to apply collision avoidance techniques.

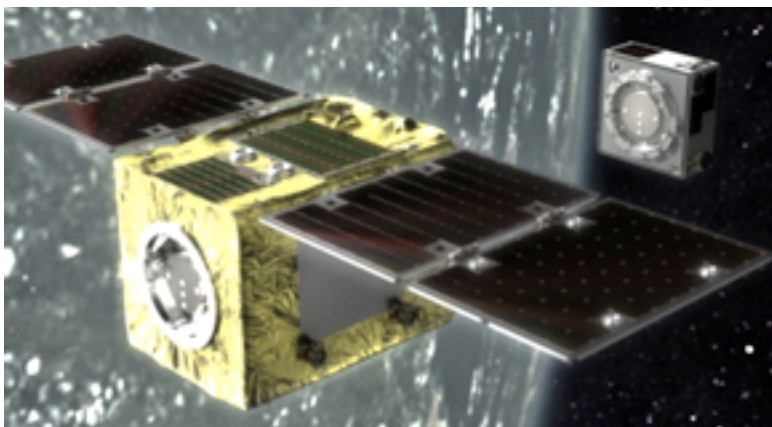
However, we are also now seeing **Active Debris Removal (ADR)** capabilities nearing development and a number of providers are preparing to offer ADR solutions. **On-Orbit Servicing (OOS)** is also now technically established, helping to extend missions and reduce orbit traffic.

Following are just a few examples of ADR solutions available. The list is not by any means exhaustive:

**SpaceLogistics**, a subsidiary of **Northrop Grumman**, has for example developed its **Mission Extension Vehicle** to provide in-orbit satellite servicing to GEO satellites, providing propulsion and altitude control. This can be very helpful in the case of low-on fuel or aging satellites.



**Astroscale**, a start-up based in Tokyo Japan, is developing a space debris removal service which aims to enable the removal of both active debris and end of life satellites. On 20th March 2021, it launched the End-of-Life Service **Elsa-D** mission, consisting of two LEO spacecraft: a 175kg "servicer" and a 17kg "client". Once in orbit, the servicer will use sensors to find and latch on to the client's magnetic docking plate. Astroscale plans to perform a number of tasks once in space, with the most complex involving the servicer 'grabbing' the client as it's tumbling.

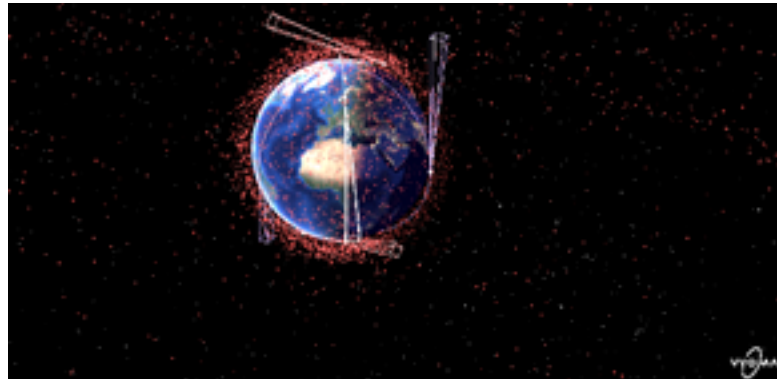


Artistic rendition of ELSA-d approaching a client satellite. Image is courtesy of Astroscale.

According to the BBC, **OneWeb**, the broadband satellite constellation that was recently part-purchased by the British government, is already putting an Astroscale-compatible docking plate on all its new spacecraft, meaning they can be collected by a servicer vehicle in the case of any on-orbit failures.

There is also the **RemoveDEBRIS** satellite from the **University of Surrey's Space Centre**, which successfully used a harpooning technique to capture space debris in 2019. The satellite was launched in 2018 with a view to performing a number of debris-capturing experiments. As well as the harpoon experiment, the satellite successfully used its on-board net to capture a simulated piece of debris, proved its **LiDAR** vision navigation system's ability to track space junk and cubesats and deployed a large dragsail to effectively speed de-orbit into the Earth's atmosphere.

German-based company **Vyoma** is due to launch its initial services platform in the spring of this year. The company combines AI and an on-board global navigation satellite system with an on-orbit optical telescope to observe and track space objects. Interestingly, the company plans to offer its services via a web platform with a monthly subscription model that scales in relation to a user's number of satellites assigned to the subscription.



There are also some ground-based laser techniques being developed, as well. **Lumi Space**, for example, has developed a laser technology that can power and recharge satellite batteries from Earth, even if a satellite's solar panels aren't in direct sunlight. This could enable satellites that are low on battery power to be recharged so they can re-enter the atmosphere or to be sent further away from Earth so as to not cause debris in usable orbits.

There's also **Lift Me Off**, which is developing and testing machine learning algorithms to distinguish between satellites and space debris, while **Fujitsu** is combining ML and quantum-style processing to improve mission planning to remove debris.



One of the biggest challenges toward developing truly effective SSA techniques is funding, as well as ensuring that the industry is taking a coordinated approach, so we are best using the funding we have available to us.

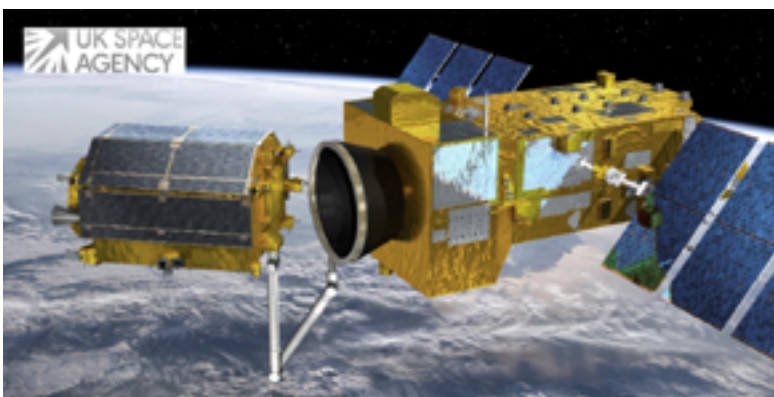
## CHALLENGES IN INNOVATION

Clearly, with so many service providers all launching and introducing their own services for debris removal and SSA at the same time, there will be some doubling up of efforts. Funding to develop these services is already difficult to come by, so are we really making the most of this valuable funding if what many companies are innovating are different versions of one another? Many of the new solutions launching are innovated by start-ups, but of course funding, is even more of an issue in this field.

There are also several organizations that seem to be replicating the SDC and [European Space Surveillance and Tracking \(EUSST\)](#) type of services.



One example is [Share My Space](#) in France and [UK Space Agency's \(UKSA\) Space Surveillance and Tracking \(SST\)](#) service. Instead of this fragmentation of resources, capital, and of course human talent, the whole industry would benefit from a more holistic, consolidated approach in our efforts.



## THE ROLE OF GOVERNMENTS IN SSA

It has long been the aim of the SDA to move toward a more government-led approach to SSA and space debris. After all, the issue of unusable space goes beyond the commercial interests of satellite operators — it's a problem that could affect all of the satellite services that Earth's population relies on, from meteorology to the military.

We would like to see the development of technology and services to tackle space debris and SSA coordinated by governments. Governments also have an important role to play in defining regulation, enforcing those rules, as well as delivering financial support for these initiatives.

The SDA has brought together operators in an effort to self-regulate the space environment and preserve its usability by sharing data, but with so much international innovation in new services, governments need to take on the responsibility of managing this.

We have begun to see some moves by governments to this end, such as the [EUSST](#) services and the decision to have the [US Department of Commerce](#) taking-over the lead civilian agency for providing basic SSA data and STM services to commercial space operators.

Another example is the Astroscale demonstration previously mentioned, which was overseen from a control center at the UK's [Satellite Applications Catapult](#) in Harwell, Oxfordshire — a site funded by the UK government which is aiming to make the United Kingdom a hub for businesses that can service and/or remove aging satellites and take on an important role in SSA.



We would like to see more governments funding projects such as this and funding committed to track and remove space debris. The alternative is to continue duplicating our efforts across the world, which is not only doubling the efforts and funding, but goes against the collaborative nature of the satellite industry, of which the SDA has been encouraging since the organization's inception.

[www.space-data.org/sda](http://www.space-data.org/sda)

*Author Pascal Wauthier is the SDA's Executive Director. He joined SES in 1990, where he leads SES Space Operations. This function is responsible for safely operating the SES GEO and MEO (O3b) satellites. This includes leading following Operational Teams: the Satellite Control Centers located in Gibraltar, Luxembourg, Manassas and Princeton as well as the Flight Dynamics Engineering, Software Engineering and Operations Architecture teams.*



